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Solutia Inc.

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St. Louis, Missouri 63141

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St. Louis, Missouri 63166-6760

Tel 314-674-1000

July 31, 2003

Mr. Nabil S. Fayoumi
U. S. Environmental Protection Agency - Region 5
Superfund Division
77 West Jackson Boulevard (SR-6J)
Chicago, Illinois 60604-3590

**Re: Groundwater Treatment Contingency Plan
Sauget Area 2 Interim Groundwater Remedy**

Dear Mr. Fayoumi,

This letter is in response to your July 10, 2003 email message requiring submission of a "contingency plan in the case that American Bottoms can not accept extracted groundwater and/or volume."

Enclosed with this letter is the Groundwater Treatment Contingency Plan which addresses your requirement.

Please call me at 314-674-6768 if you have any questions.

Sincerely,

Gary Vandiver
Project Coordinator
Solutia Inc.

cc: Sandra Bron - IEPA
Steven Acree - USEPA
Ken Bardo - USEPA
Mike Coffey - USF&W
Tim Gouger - USACE
Peter Barrett - CH2M Hill

Linda Tape - Husch & Eppenberger
Gary Vandiver - Solutia
Richard Williams - Solutia
Bruce Yare - Solutia



LETTER OF TRANSMITTAL

From: Bruce Yare
575 Maryville Centre Drive
St. Louis, MO 63141
(314) 674-4922 FAX (314) 674-8957

Nabil Fayoumi

Date: 7/31/03

Sauget Area 2

Interim Groundwater Remedy

The following items are:

☒ Enclosed ☐ Requested ☐ Sent Separately Via: _____

No. of Copies	Description
3	Groundwater Treatment Contingency Plan
3	Groundwater Treatment Contingency Plan Cost Estimate
3	Hydraulic Control Timetable Tech Memo
3	Barrier Wall Bedrock Flow Tech Memo
3	Disturbed Area Storm Water Treatment System

The above items are submitted:

☒ At your request ☐ For your review ☐ For your signature
☐ For your files ☐ For your action ☐ For your information

Comments:

By: Bruce Yare for
Gary Vandiver, Project Coordinator



THE ADVENT GROUP, INC.

July 28, 2003

Mr. Bruce Yare
575 Maryville Centre Drive
Mails Code 6S
St. Louis MO, 63141
bsyare@solutia.com

Subject: **Groundwater Treatment Contingency Plan
ADVENT Project 02691**

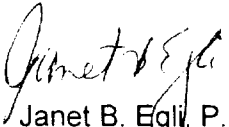
Dear Mr. Yare:

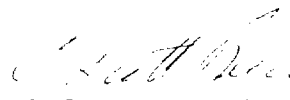
Please find enclosed the *Groundwater Treatment Contingency Plan* for installing granular activated carbon treatment for the groundwater discharged from Site R at the Solutia Krummrich Facility.

If you have any questions or require additional information, please call us at (615) 377-4775.

Sincerely,

The ADVENT Group, Inc.


Janet B. Egli, P.E.
Project Manager


C. Scott Reece, P.E.
Principal

cc: Richard Williams, Solutia (without attachments)

GROUNDWATER TREATMENT CONTINGENCY PLAN

Sauget Area 2 Groundwater Migration Control System

Prepared for:



SOLUTIA INC.

St. Louis, Missouri

Prepared by:



The ADVENT Group, Inc.
201 Summit View Drive, Suite 300
Brentwood, TN 37027

July 2003

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LIST OF ATTACHMENTS

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1	Engineering Drawings
2	Engineering Sketches & Calculations
3	Equipment <ul style="list-style-type: none">- Major Equipment List- Line List- Process Hose List- Non-Instrument Process Valve List- Electrical Requirements- 3A Carbon Column Data Sheets & Vendor Information- 3B Pump Data Sheets & Vendor Information- 3C Tank Data Sheet- 3D Compressor Data Sheet & Vendor Information
4	Technical Specifications <ul style="list-style-type: none">- Mechanical- Electrical
5	Instrumentation <ul style="list-style-type: none">- Field Instrument List- Instrument Data Sheets & Vendor Information
6	Operations and Maintenance <ul style="list-style-type: none">- Calgon Carbon Corporation Dual Module Operating Manual- Calgon Carbon Corporation Dual Module System Description

GROUNDWATER TREATMENT CONTINGENCY PLAN

In accordance with the Administrative Order for Remedial Design and Interim Remedial Action (Docket No. V-W-02-C-716), issued by USEPA Region 5 on October 3, 2002, a Remedial Design for a Groundwater Migration Control System is being prepared that consists of a 3,300 ft. long, U-shaped barrier wall and three groundwater extraction wells installed on the upgradient side of the barrier wall. This Groundwater Migration Control System is being installed to control the discharge of impacted groundwater to surface water downgradient of Sauget Area 2 Sites O, Q (Dog Leg), R and S; Sauget Area 1 Sites G, H I and L; the W.G. Krummrich plant, and other industrial facilities in the Sauget Area.

On July 9, 2003, the American Bottoms Regional Wastewater Treatment Facility issued Discharge Permit No. 03B - 138 for the discharge of UAO Remediation Wastewater from the Sauget Area 2 Groundwater Migration Control System. This permit granted permission to discharge UAO Remediation Wastewater into sewer lines tributary to the American Bottoms Wastewater Treatment Plant in accordance with and subject to the provisions of the discharge permit, which became effective on July 10, 2003 and expires on August 1, 2004. Part 6.D, Special Conditions, Additional Permit Terms and Conditions, of the permit requires the following:

1. When and as directed by the POTW, Solutia shall control the commencement, reduction or resumption or the discharge of UAO Remediation Wastewater, including but not limited to, limitations on flow rate, flow volume and mass loadings of specific contaminants.
2. When directed by the POTW, Solutia shall immediately cease the discharge of UAO Remediation Wastewater or adjust the flow to protect against threats to the integrity of the POTW treatment processes, worker safety or the environment.

In a July 1, 2003 letter on a preliminary startup schedule for discharge of UAO Remediation Wastewater, American Bottoms indicated that "should it appear that there is process inhibition, particularly to the nitrification process, or that plant effluent or water quality standards might be in jeopardy, the Site R discharge may be reduced."

Based on these permit conditions and discharge limitations during startup, USEPA notified Solutia on July 10, 2003 that it "should submit a contingency plan in the case that American Bottoms can not accept extracted groundwater and/or volume" by July 31, 2003.

This Groundwater Treatment Contingency Plan is submitted to meet this requirement. When American Bottoms is unable to accept discharge of extracted groundwater in a reasonable period of time after ordering a cessation of discharge, transportable Granular Activated Carbon (GAC) beds will be mobilized to the site and connected to an existing piping system using quick connect couplings and flexible hoses. Such a system allows rapid employment of treatment and minimizes the costs associated with a standby treatment system. If the Contingency Plan needs to be implemented for a significant period of time, further cost reductions will be achieved by incorporating an oxidation unit into the treatment train prior to the GAC beds and reducing carbon usage.

Solutia will discharge the treated effluent from the backup treatment system directly to the Mississippi River.

1.0 PROCESS OVERVIEW

Table 1 presents the process design for backup GAC treatment of the Site R groundwater. The activated carbon system has been designed to remove total organic carbon (TOC), composed primarily of chlorinated and/or aminated aromatic compounds, from the groundwater. This design was developed based on anticipated flows following barrier wall installation and influent characteristics observed during the May 2003 pump test, as well as operational flexibility.

Each extraction well will have a nominal pumping capacity of 667 gpm, and the total nominal capacity of the extraction system is 2,000 gpm (2.88 MGD). The maximum anticipated flow is 1,900 gpm (2.74 MGD) prior to installation of the barrier wall and 950 gpm (1.37 MGD) after installation of the barrier wall. The GAC system presented herein has been designed for treating extracted groundwater after installation of the barrier wall with flows of 600 gpm (0.86 MGD) as the design average flow and 1,000 gpm (1.44 MGD) as the maximum design flow. However, if the Contingency Plan is implemented

prior to barrier wall installation or during any other time of higher flows, additional GAC treatment can be provided, if required. Following site preparation, additional skid mounted units can easily be brought to the site for treating the increased loading.

In the event the Contingency Plan is implemented for a significant period of time, oxidation may be employed to reduce carbon usage. Table 2 presents the process design for the backup GAC treatment system, including groundwater ozonation prior to carbon treatment. This design was based on results of the ozonation treatability study conducted during the May 2003 Pump Test. Results from that study indicate that ozone will reduce some of the organic compounds in the groundwater. Approximately 15 percent of the groundwater TOC was removed by ozonation.

Although the activated carbon system has been designed such that continuous operator attendance is not necessary during normal operations, an operator will be needed for manual operation of the valves and pumps associated with the carbon transfer operations. Based on average carbon replacement projections, the system will need operator attention for eight hours approximately every two days (or every three days with ozone) for carbon transfer. In addition, routine monitoring of the effluent will be required to determine carbon breakthrough.

No on-site regeneration has been included in this design, although that is a possible future option. Vendor-supplied trailers will be used to remove spent carbon from the adsorbers and also recharge the adsorbers with fresh activated carbon. Air and water requirements for the carbon transfer are included in Table 3. Treated effluent from the system will be stored in a 12,000-gallon tank and will serve as backflush and transfer water required during carbon changeout. Carbon transfer air will be supplied by a compressor.

2.0 CARBON TREATMENT SYSTEM OVERVIEW

A total of four dual-module column systems (eight total columns) is proposed. Each skid-mounted unit consists of two columns designed to allow parallel or lead-lag (series) operation. Each column will be charged with 20,000 lbs of granular activated carbon. The expected mode of operation of each dual-module system will be lead-lag to ensure

effluent quality and maximize carbon utilization. Based on projected solids concentrations of the groundwater, no prefiltration equipment is deemed necessary.

Each column includes process piping to allow backflush of fresh carbon after the completion of a carbon changeout. This backflush will remove carbon fines, other accumulated solids and air. Section 3.4 provides a complete description of carbon transfer. The columns will be approximately 10-ft diameter by 9-ft straight side height with an overall height of 15 ft to the top of the associated piping. Each column will be ASME rated and furnished with a rupture disc for protection if the system pressure exceeds the vessel pressure rating.

The current design of the carbon columns is based on the Calgon Dual Module system. These units are skid-mounted systems that are transported pre-assembled on a trailer and can be installed and removed from the site relatively easily. The skids are removed from the trailers by crane and can then be put in place onto supports.

The carbon will be delivered separately from the columns and transferred from a trailer. The initial carbon fill will take approximately 36 to 40 hours for all eight columns to be filled and will require between 60,000 and 70,000 gallons of water. This water will be transported to the site by truck or by connecting to a 10-in water line at the Site R Pole Barn located on the north side of Riverview Road. The transfer water must be clean and will remain in the columns for a minimum of eight hours to thoroughly wet the carbon. The columns must then be backflushed to remove fines and settle the beds. A total of three to four days will be required for installation once the columns have been delivered to the site.

This design requires a pad to place the dual-modules and appurtenances. The dimensions of the pad are approximately 30 x 110 feet. Provisions should be made to insulate all of the permanent above-ground process piping and equipment for the system. Heat tracing will be installed on all piping that could contain non-flowing water. Drains will be installed to empty pipes when the system is dormant and the carbon columns have been removed. Carbon columns can be protected by wrapping heating blankets around the valve tree.

2.1 Influent Characterization

Table 4 presents results of all constituents analyzed in the extracted groundwater prior to GAC treatment during the May 2003 pump test. Most parameters analyzed were not detected, or sporadically detected at concentrations near the listed detection limits. All parameters, which were identified at a concentration of 1.0 mg/L or higher are summarized below:

Parameter	Units	Influent Concentration Range
<u>Metals</u>		
Calcium	mg/L	260 – 280
Iron	mg/L	17 – 20
Magnesium	mg/L	61 – 65
Manganese	mg/L	2.6 – 2.9
Potassium	mg/L	14 – 15
Sodium	mg/L	120 – 150
Total Organic Carbon	mg/L	130 – 180
Chemical Oxygen Demand	mg/L	446 – 600
Biochemical Oxygen Demand	mg/L	126 – 143
Total Suspended Solids	mg/L	4 – 36
Ammonia	mg/L	10.3 – 14.9
Total Kjeldahl Nitrogen	mg/L	14.8 – 27.6
<u>Volatiles</u>		
Chlorobenzene	mg/L	2.3 – 3.9
Toluene	mg/L	0.7 – 1.2
Acetone	mg/L	3.0 – 6.7
<u>Semi-Volatiles</u>		
2-Chloroaniline	mg/L	22 – 31
4-Chloroaniline	mg/L	12 – 21
Aniline	mg/L	17 – 35
Phenol	mg/L	3.4 – 6.5
2-Nitrochlorobenzene	mg/L	3.7 – 25
3-Chloroaniline	mg/L	14 – 37
4-Chlorophenol	mg/L	2.8 – 7.1
4-Nitrochlorobenzene	mg/L	1.1 – 7.5

The TSS concentration in the groundwater received from the collector wells averaged approximately 13 mg/L. Because of the frequent carbon changeout, only a small amount of solids accumulation is expected in the carbon beds, which should not impact the hydraulic efficiency of the adsorbers. If higher solids concentrations are observed in the future, provisions for prefiltration equipment have been made. Additional piping connections, to which a bag filter system or other solids collection equipment can be attached, are shown on the P&IDs. In the event ozonation is employed to reduce carbon usage, this connection point may be used to attach clarification equipment if needed to remove precipitated iron from the system prior to carbon treatment.

2.2 Process

A total carbon lead column surface area of 314 ft² is provided by the four dual-module units proposed. However, because of the high frequency of carbon changeout (i.e. potential daily lead column carbon replacement) only three trains will typically be operating. At an influent flow of 1,000 gpm, three dual-module systems will provide a contact time of 14 minutes per lead adsorber. This value corresponds to a surface loading rate of 4.2 gpm/ft² when three trains are operating at maximum capacity. At the projected average flow of 600 gpm, the three operating trains will provide a contact time of 24 minutes per lead adsorber at a surface loading rate of 2.5 gpm/ft².

The anticipated influent TOC concentration and corresponding carbon utilization demand are provided in Table 1. The carbon demand has been estimated based on results of the pump test demonstration, 0.103 lbs TOC per lb of GAC, which is considered a reasonable estimate for the reactivated carbon used during the study. Because the lead column was not run to total exhaustion during the pump test, the adsorptive capacity used in the Contingency Plan represents a conservative estimate. The effluent quality achieved following lead/lag carbon treatment during the pump test demonstration is shown in Table 5.

Based on the developed capacity, the maximum carbon usage rate is estimated at 14,600 lbs/day without pre-ozonation, 12,200 lbs/day with pre-ozonation. This usage rate would require that one lead column be changed out every 1.4 days without pre-ozonation (1.6 days with pre-ozonation) during operation, provided that the startup of the units is staggered in order to prevent simultaneous breakthrough in all four units.

Attachment 1 presents all engineering drawings. Attachment 2 includes all engineering sketches and calculations. Equipment information, including electrical requirements and equipment data sheets, are provided in Attachment 3. Sufficient power is currently available at the site for all of the necessary equipment for the GAC treatment system. Technical specifications are provided in Attachment 4. Attachment 5 presents instrumentation information. Operation and maintenance information is provided in Attachment 6.

3.0 OPERATION

This section provides operating guidelines and information for monitoring and troubleshooting of the GAC backup treatment system. It does not present detailed maintenance procedures, as vendor equipment information manuals provide such details. The intent of this section is to summarize the basic operation and control of the GAC backup treatment system.

3.1 Equipment Description

A total of four dual-module column systems (eight total columns) will comprise the GAC backup treatment system. These units are skid-mounted systems that are transported pre-assembled on a trailer and can be installed and removed from the site relatively easily. The current system design is based around the Calgon Carbon Corporation Dual Module system. (The Operating Manual for these units, prepared by Calgon Carbon Corporation, is presented as Attachment 6 and contains detailed equipment information and recommended operation and maintenance for these units. Also included in Attachment 6 is a complete system description for the Dual Module units furnished by Calgon Corporation.) Each skid-mounted unit consists of two columns designed to allow parallel or lead-lag (series) operation. Each column will be charged with 20,000 lbs of granular activated carbon. The skids are removed from the trailers by crane and then dropped in place onto supports. Each column is provided with process piping to allow backflush of fresh carbon after the completion of a carbon changeout. This backflush will remove carbon fines, other accumulated solids and air.

3.2 Normal Operation

When operation of the backup GAC system is required, groundwater will be pumped from the collector wells through an 8-in header and will be distributed to all operating carbon adsorber trains. Flow into each pair of carbon adsorbers will be measured (FIQ-1 through FIQ-4) and totalized.

From the influent header, groundwater will enter the valve manifold of each dual-module unit. The valves on this manifold will be manually manipulated so that the influent passes through the lead (primary adsorption) column and lag (polishing) column in series. Flow

exiting the lag column will re-enter the valve manifold and then be directed to the effluent header for ultimate discharge at the Mississippi River.

A portion of the treated effluent will be routed to the Backflush Supply Tank (T-1) for use during carbon transfer. This tank is 14 ft diameter by 12 ft high, with a working water depth of 10 ft – 6 in. The level in the tank will be kept constant by a float-activated level control valve (LCV-1). The working capacity of the tank is approximately 12,000 gallons, which will provide enough water to complete one full transfer operation during carbon changeout.

3.3 Alternate Operation

The expected mode of operation of each dual-module system is lead-lag. However, the skid-mounted units described herein can be operated in parallel based on required level of treatment. Parallel operation can be initiated by manually manipulating the valves on the vendor supplied valve manifold so that the influent to the system is equally distributed to both units.

3.4 Operation During Carbon Transfer

Vendor-supplied trailers will be used as necessary for direct slurry transfer of spent carbon from the adsorbers into the trailers and direct slurry transfer of fresh activated carbon from the trailers into the adsorbers. Utility connections have been included in the design to provide the air and water needed for carbon transfer. Upon trailer arrival, the adsorber scheduled for carbon replacement will be manually taken off-line. Compressed air, supplied by compressor C-1, will be used to pressurize the adsorber to 25 to 30 psig before initiating transfer of the spent carbon from the adsorber to the trailer. Spray water will be added to the top of the column through a 2-in spray nozzle to knock down any carbon attached to the sides of the vessel and ensure that all of the spent carbon is expelled from the column. Treated effluent will be used for spray water and supplied to the column by pump P-2. The transfer of spent carbon from the vessel to the trailers will take 20 to 30 minutes. Once the spent carbon transfer is complete, the transfer water will be drained from the trailer through pump P-3 and returned to the influent header.

The vendor-supplied trailer will also deliver fresh activated carbon to the site. The trailer will be pressurized and the fresh carbon slurry transferred to the empty adsorber. The total time required for carbon exchange (pressurizing the trailer, removing spent carbon, flushing the carbon vessel, transferring fresh carbon to the vessels, etc.) is 4 to 6 hours. Once filled with fresh activated carbon, the adsorber must be backflushed at a rate of 225 gpm to remove fines. A manual switch will activate and deactivate the backflush pump (P-1) to supply the needed flush. Backflush return water will be routed to the 8-in effluent line. The carbon should arrive at the site pre-wetted. The water used for transfer should remain in the carbon columns for about 8 hours after transfer is complete to thoroughly soak the carbon and purge any air entrained in the carbon.

3.5 Startup/Shutdown

Because carbon treatment is anticipated to occur on an intermittent basis, the piping system for the backup GAC system has been designed as a diversion for the line transferring groundwater to ABRTF. When the American Bottoms Regional Treatment Facility directs Solutia to reduce or cease the discharge of extracted groundwater, the valve on the influent header of the carbon treatment system will be opened and the valve on the effluent header closed; thus, all extracted groundwater will be carbon treated and discharged to the Mississippi River. When carbon treatment is not required, the groundwater will flow directly to ABRTF. If the carbon adsorbers are left on-site while not in use, the units should remain filled with water to prevent air entrainment in the GAC. However, during the winter months, if the carbon columns need to stay on-site and empty of water, the carbon will need to be soaked with clean water to purge the air before the units are put back in service. When the units are removed from the site, the vessels and process piping will be emptied.

3.6 Routine Monitoring

Field instrumentation for the carbon treatment system includes online measurements of flow to each pair of adsorbers and pressure measurements throughout the valve manifold of each dual-module unit. Operators will take daily measurements for total flow, temperature, pH, COD, and TOC of the groundwater. Analysis for TOC must be expedited to identify a breakthrough condition as quickly as possible. Breakthrough

times will be estimated using on the influent flow and TOC loading based on the adsorptive capacity of the GAC estimated during the pump demonstration test.

3.7 Potential Operating Problems and Corrective Actions

The following table lists potential problems, probable causes, and corrective actions related to the carbon treatment system. Troubleshooting problems with specific pieces of equipment or instruments is discussed in the vendor-supplied manuals.

PROBLEM		PROBABLE CAUSE		CORRECTIVE ACTION
High pressure drop across adsorber.	1.	Bed not flooded or is air bound.	1.	Open vent valve or carbon inlet valve to release pressure. Add water upflow to fill vessel. Establish constant forward flow, then close valve.
	2.	High feed pump pressure.	2.	Throttle feed pump.
	3.	High suspended solids loading or carbon fines around the nozzles.	3.	Test feed for suspended solids. Install influent filter. Backflush the adsorber.
	4.	Improper valve settings.	4.	Check valve sequence.
Leaking flange.	1.	Loose bolts.	1.	Tighten bolts.
Excessive flow out vent line.	1.	Broken rupture disk.	1.	Check the following conditions before replacing disk: 1) Check downstream valving to make sure that the system is not plugged off. 2) Check feed pump pressure to make sure it is not too high. 3) Check process valve sequence. 4) Check that excessive pressure build-up did not occur in closed vessels during extended shutdowns. Once the potential source of overpressurization is removed, replace rupture disk.
Carbon in the effluent.	1.	Internal mechanical (i.e. underdrain) failure.	1.	Check for carbon in the effluent to confirm. Determine which adsorber is causing the problem, then remove carbon and make repairs.
Sudden high contaminant concentration in effluent.	1.	Carbon heel from improper transfer.	1.	Wait until contaminant flushes out. Review transfer procedures.
	2.	Leaking valve.	2.	Repair/replace valve.
	3.	Mass transfer zone has extended into effluent.	3.	Replace carbon.
Premature breakthrough of organics in the effluent.	1.	Influent concentration change.	1.	Confirm by analyzing effluent sample(s) before changing carbon.
	2.	Air in the influent stream.	2.	Open vent valve and fill bed upflow with water as required.

PROBLEM	PROBABLE CAUSE		CORRECTIVE ACTION
Carbon heel in empty vessel.	3.	Background TOC or colloids present.	3. Change carbon.
	4.	Leaking valves.	4. Check operation of valves in influent and effluent lines.
	5.	Incorrect valve sequence.	5. Sequence the flow through the system properly.
	1.	Insufficient rinse water.	1. Provide additional rinse water flow.
	2.	Mechanical failure.	2. Check vessel internal parts and make repairs.
	3.	Foreign material on the carbon.	3. Rinse vessel to remove carbon.

3.8 Safety Plan

Site safety requirements should be adhered to at all times. Safety hazards associated with carbon treatment include low oxygen content of vessels containing wet, drained activated carbon. Studies have shown that low oxygen content exists in vessels containing wet drained GAC. The laboratory experiments conducted since that time also have revealed that commercial activated carbons in a wet or moist condition will lower the oxygen content of an isolated space.

Preliminary indications of this research are:

1. The phenomenon occurs with all types of wet activated carbon.
2. The rate of oxygen uptake naturally varies with the degree of exposure of the wet carbon to the air. Thus, it is relatively rapid in a drained bed.
3. There is some indication of a limit to the carbon's capacity for oxygen, but until more is known, it would be prudent to assume that all carbons (fresh, used, reactivated) will also exhibit this characteristic. Similarly, although these tests were run with water, it should be assumed that the phenomenon will occur in other liquid and vapor systems.

Based on the properties of wet activated carbon, a confined space entry procedure should be established for any facility using carbon in confined vessels.

All confined spaces, including those containing activated carbon, should be presumed to be hazardous. Appropriate safety measures should always be taken before entering, as well

as when workers are in a confined space. OSHA regulations applicable to respiratory protection in oxygen deficient atmospheres should be strictly adhered to.

3.9 Ozonation Operation

If the Contingency Plan is implemented for a significant period of time and Solutia elects to install ozonation treatment, the ozonation system operation details will be provided by the selected ozone system supplier. In general, the system operator will inspect the process daily and adhere to the operating requirements provided by the suppliers to ensure effective and safe operations.

**TABLE 1. ACTIVATED CARBON BACKUP TREATMENT OF GROUNDWATER
PROCESS DESIGN
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	VALUE	COMMENTS
DESIGN BASIS			
Influent			
Maximum Hydraulic Capacity	gpm	1,000	Following Barrier Wall Installation
	mgd	1.44	
Average Flow	gpm	600	Based on May 2003 Pump Test
	mgd	0.86	
TSS	mg/L	13	Based on May 2003 Pump Test Used for Design Average conditions
	lb/d	156	
TOC	mg/L	142	
	lb/d	1,704	
	lb/d	1,022	
ACTIVATED CARBON SYSTEM			
Activated Carbon System			
Hydraulic Loading Rate	gpm/ft ²	3	Design basis average flow conditions
	gpm/ft ²	6	Peak acceptable rate.
Total Carbon Area Required	ft ²	200	Based on average flow
	ft ²	167	Based on maximum hydraulic capacity
Columns			
Carbon Bed Height	ft	8	Based on average flow
Column Diameter (Each)	ft	10	
Surface Area Per Column	ft ²	78.5	
Carbon Bed Volume	ft ³	628	
Number of Columns Required	--	2.5	Based on maximum hydraulic capacity
Number of Columns Required	--	2.1	
Number Dual Systems Required	--	3	Based on carbon changeout frequency
Number Dual Systems Provided	--	4	
Lead Surface Area Provided	ft ²	314	Based on maximum hydraulic capacity
Lead Surface Area, Operating	ft ²	236	
Hydraulic Loading, Operating	gpm/ft ²	4.2	Based on average flow
	gpm/ft ²	2.5	

**TABLE 1. ACTIVATED CARBON BACKUP TREATMENT OF GROUNDWATER
PROCESS DESIGN
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	VALUE	COMMENTS
ACTIVATED CARBON SYSTEM (continued)			
Carbon in a Column	lb	20,000	
Lead Carbon Charge Operating	lb	60,000	
Lead Carbon Charge, Total	lb	80,000	
Total Carbon Charge	lb	160,000	
Projected Effluent			
TOC Concentration	mg/L	16	Based on May 2003 Pump Test Maximum flow Average flow
TOC Mass	lb/d	192	
	lb/d	115	
Carbon Demand			
Carbon Capacity	g TOC/g carbon	0.10	Based on 50% Breakthrough During May 2003 Pump Test
Maximum Hydraulic Flow			
Carbon Usage	ton/d	7.3	
Number of Columns per Changeout	--	1.0	
Carbon per Changeout	ton/changeout	10	
Run Time Between Changeouts	days	1.36	
Changeouts per Year	change/yr	268	
Carbon Usage per Year	ton/yr	2,680	
Average Flow			
Carbon Usage	ton/d	4.4	
Carbon per Changeout	ton/changeout	10	
Run Time Between Changeouts	days	2.27	
Changeouts per Year	change/yr	161	
Carbon Usage per Year	ton/yr	1,610	
Backflush Pumps			
Backflush rate	gpm	225	
	gpm/ft ²	3	
Number of Pumps Operating	--	1	
Number of Pumps Provided	--	1	
Type of Pump	--	Centrifugal	
Total Design Head	ft	15	
Horsepower	hp	3	
Total Operating Power Requirements	hp	5	
Total Connected Load	hp	5	

**TABLE 1. ACTIVATED CARBON BACKUP TREATMENT OF GROUNDWATER
PROCESS DESIGN
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	VALUE	COMMENTS
CARBON TRANSFER			
Carbon Spray Water Pump			
Transfer rate	gpm	100	
Number of Pumps Operating	--	1	
Number of Pumps Provided		2	Includes uninstalled spare
Type of Pump	--	Centrifugal	
Total Design Head	ft	150	
Horsepower	hp	9	
Total Operating Power Requirements	hp	10	
Total Connected Load	hp	10	
Carbon Trailer Transfer Pump			
Transfer rate	gpm	100	
Number of Pumps Operating	--	1	
Number of Pumps Provided		2	Includes uninstalled spare
Type of Pump	--	Centrifugal	
Total Design Head	ft	150	
Horsepower	hp	2	
Total Operating Power Requirements	hp	5	
Total Connected Load	hp	5	
Compressor			
Air Supplied	scfm	100	
Discharge Pressure	psig	30	
Horsepower	hp	15	
BACKFLUSH STORAGE			
Total Storage			
Capacity	gal	12,000	Total requirement.
Number of Tanks Provided	--	1	
Tank Height	ft	12	10.5 ft SWD
Tank Diameter	ft	14	

**TABLE 2. ACTIVATED CARBON BACKUP TREATMENT OF GROUNDWATER
WITH OZONE PRETREATMENT PROCESS DESIGN
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	VALUE	COMMENTS
OZONATION DESIGN BASIS			
Influent			
Maximum Hydraulic Capacity	gpm	1,000	Following Barrier Wall Installation
	mgd	1.44	
Average Flow	gpm	600	Based on May 2003 Pump Test
	mgd	0.86	
TSS	mg/L	13	Maximum Conditions
	lb/d	156	Based on May 2003 Pump Test
TOC	mg/L	142	
	lb/d	1,704	Maximum Conditions
	lb/d	1,022	Average Conditions
COD	mg/L	500	Based on May 2003 Pump Test
	lb/d	6,005	
	lb/d	3,603	Average Conditions
OZONATION SYSTEM			
Ozone Requirements			
Dosage	lb O ₃ /lb COD	3	Based on May 2003 Pump Test
Ozone Required	lb O ₃ /day	18,014	
		10,809	Average Conditions
Projected Effluent			
TOC Removal	%	15	Based on May 2003 Pump Test
TOC Concentration	mg/L	121	
TOC Mass	lb/d	1,450	Maximum flow
	lb/d	870	
			Average Flow
GAC DESIGN BASIS			
Influent			
Maximum Hydraulic Capacity	gpm	1,000	Following Barrier Wall Installation
	mgd	1.44	
Average Flow	gpm	600	
	mgd	0.86	

**TABLE 2. ACTIVATED CARBON BACKUP TREATMENT OF GROUNDWATER
WITH OZONE PRETREATMENT PROCESS DESIGN
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	VALUE	COMMENTS
GAC DESIGN BASIS (continued)			
TSS	mg/L	13	Based on May 2003 Pump Test
TOC	lb/d	156	Based on May 2003 Pump Test Used for Design Average conditions
	mg/L	121	
	lb/d	1,448	
	lb/d	869	
ACTIVATED CARBON SYSTEM			
Activated Carbon System			
Hydraulic Loading Rate	gpm/ft ²	3	Design basis average flow conditions
Total Carbon Area Required	gpm/ft ²	6	Peak acceptable rate.
	ft ²	200	Based on average flow
	ft ²	167	Based on maximum hydraulic capacity
Columns			
Carbon Bed Height	ft	8	
Column Diameter (Each)	ft	10	
Surface Area Per Column	ft ²	78.5	
Carbon Bed Volume	ft ³	628	
Number of Columns Required	--	2.5	Based on average flow
Number of Columns Required	--	2.1	Based on maximum hydraulic capacity
Number Dual Systems Required	--	3	
Number Dual Systems Provided	--	4	Based on carbon changeout frequency
Lead Surface Area Provided	ft ²	314	
Lead Surface Area, Operating	ft ²	236	
Hydraulic Loading, Operating	gpm/ft ²	4.2	Based on maximum hydraulic capacity
	gpm/ft ²	2.5	Based on average flow
Carbon in a Column	lb	20,000	
Lead Carbon Charge Operating	lb	60,000	
Lead Carbon Charge, Total	lb	80,000	
Total Carbon Charge	lb	160,000	

**TABLE 2. ACTIVATED CARBON BACKUP TREATMENT OF GROUNDWATER
WITH OZONE PRETREATMENT PROCESS DESIGN
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	VALUE	COMMENTS
ACTIVATED CARBON SYSTEM (continued)			
Projected Effluent			
TOC Concentration	mg/L	16	Based on May 2003 Pump Test
TOC Mass	lb/d	192	Maximum flow
	lb/d	115	Average flow
Carbon Demand			
Carbon Capacity	g TOC/g carbon	0.10	Based on 50% Breakthrough During May 2003 Pump Test
Maximum Hydraulic Flow			
Carbon Usage	ton/d	6.1	
Number of Columns per Changeout	--	1.0	
Carbon per Changeout	ton/changeout	10	
Run Time Between Changeouts	days	1.64	
Changeouts per Year	change/yr	223	
Carbon Usage per Year	ton/yr	2,230	
Average Flow			
Carbon Usage	ton/d	3.7	
Carbon per Changeout	ton/changeout	10	
Run Time Between Changeouts	days	2.73	
Changeouts per Year	change/yr	134	
Carbon Usage per Year	ton/yr	1,340	
Backflush Pumps			
Backflush rate	gpm	225	
	gpm/ft ²	3	
Number of Pumps Operating	--	1	
Number of Pumps Provided		1	
Type of Pump	--	Centrifugal	
Total Design Head	ft	15	
Horsepower	hp	3	
Total Operating Power Requirements	hp	5	
Total Connected Load	hp	5	
CARBON TRANSFER			
Carbon Spray Water Pump			
Transfer rate	gpm	100	
Number of Pumps Operating	--	1	

**TABLE 2. ACTIVATED CARBON BACKUP TREATMENT OF GROUNDWATER
WITH OZONE PRETREATMENT PROCESS DESIGN
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	VALUE	COMMENTS
CARBON TRANSFER (continued)			
Number of Pumps Provided		2	Includes uninstalled spare
Type of Pump	--	Centrifugal	
Total Design Head	ft	150	
Horsepower	hp	9	
Total Operating Power Requirements	hp	10	
Total Connected Load	hp	10	
Carbon Trailer Transfer Pump			
Transfer rate	gpm	100	Includes uninstalled spare
Number of Pumps Operating	--	1	
Number of Pumps Provided		2	
Type of Pump	--	Centrifugal	
Total Design Head	ft	150	
Horsepower	hp	2	
Total Operating Power Requirements	hp	5	
Total Connected Load	hp	5	
Compressor			
Air Supplied	scfm	100	
Discharge Pressure	psig	30	
Horsepower	hp	15	
BACKFLUSH STORAGE			
Total Storage			
Capacity	gal	12,000	Total requirement.
Number of Tanks Provided	--	1	10.5 ft SWD
Tank Height	ft	12	
Tank Diameter	ft	14	

TABLE 3. GAC TREATMENT SYSTEM TRANSFER AIR AND WATER REQUIREMENTS ⁽¹⁾
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS

UTILITY	SOURCE	FLOW	DURATION ⁽³⁾	PRESSURE
Carbon transfer air (column)	Carbon Transfer Compressor, C1	40 ACFM		100 psig
Carbon transfer air (trailer)	Carbon Compressor, C1	40 ACFM		100 psig
Carbon backflush water	Backflush Tank T-1	400 gpm	5 min	55' TDH
Carbon spray water	Backflush Tank T-1	100 gpm	5 min	60 psig
Carbon transfer water ⁽²⁾	Backwash Tank T-1	100 gpm	30 min	30 psig

Notes:

1. All utilities will be provided from the compressor and the effluent water at the site.
2. Carbon will be dewatered following transfer, prior to transport.
3. Durations listed are for one 20,000 lb transfer.

**TABLE 4. GROUNDWATER CHARACTERIZATION SUMMARY
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Miscellaneous				
Total Organic Carbon	mg/L	141.5	130	180
Ammonia	mg/L	13.1	10.3	14.9
TKN	mg/L	19	16	22.6
TSS	mg/L	13	2.6	36.2
BOD	mg/L	138	126	162
COD	mg/L	496.7	446	600
Metals				
Silver	mg/L	<0.01	<0.01	<0.01
Aluminum	mg/L	<0.2	<0.2	<0.2
Arsenic	mg/L	<0.01	<0.01	<0.01
Barium	mg/L	0.4805	0.4	0.52
Beryllium	mg/L	<0.004	<0.004	<0.004
Calcium	mg/L	268	260	280
Cadmium	mg/L	<0.005	<0.005	<0.005
Cobalt	mg/L	<0.01	<0.01	<0.01
Chromium	mg/L	<0.01	<0.01	<0.01
Copper	mg/L	0.02125	0.02	0.035
Iron	mg/L	18.9	17	20
Mercury	mg/L	<0.0002	<0.0002	<0.0002
Potassium	mg/L	14.6	14	15
Magnesium	mg/L	63	61	65
Manganese	mg/L	2.8	2.6	2.9
Sodium	mg/L	124	120	150
Nickel	mg/L	<0.04	<0.04	<0.04
Lead	mg/L	<0.005	<0.005	<0.005
Antimony	mg/L	<0.02	<0.02	<0.02
Selenium	mg/L	<0.01	<0.01	<0.01
Thallium	mg/L	<0.01	<0.01	<0.01
Vanadium	mg/L	<0.01	<0.01	<0.01
Zinc	mg/L	0.048	0.041	0.064
Volatiles				
1,1-Dichloroethene	ug/L	<20	<20	<20
1,2-Dichloroethene (total)	ug/L	<100	<100	<100
2-Butanone (MEK)	ug/L	<200	<200	<200
2-Hexanone	ug/L	<200	<200	<200
Benzene	ug/L	447	300	500
4-Methyl-2-pentanone (MIBK)	ug/L	<200	<200	<200
Bromoform	ug/L	<20	<20	<20
Carbon tetrachloride	ug/L	<20	<20	<20
Chlorobenzene	ug/L	3185	2300	3900
cis-1,3-Dichloropropene	ug/L	<20	<20	<20
trans-1,3-Dichloropropene	ug/L	<20	<20	<20
Chloroethane	ug/L	31	20	63
2-Chloroethylvinyl ether	ug/L	<200	<200	<200

**TABLE 4. GROUNDWATER CHARACTERIZATION SUMMARY
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Chloroform	ug/L	<20	<20	<20
1,1-Dichloroethane	ug/L	<20	<20	<20
1,2-Dichloroethane	ug/L	<20	<20	<20
1,2-Dichloropropane	ug/L	36	20	330
Ethylbenzene	ug/L	90	66	100
Methylene chloride (Dichloromethane)	ug/L	<100	<100	<100
1,1,2,2-Tetrachloroethane	ug/L	<20	<20	<20
Toluene	ug/L	977	720	1200
trans-1,2-Dichloroethene	ug/L	<20	<20	<20
1,1,1-Trichloroethane	ug/L	<20	<20	<20
1,1,2-Trichloroethane	ug/L	<20	<20	<20
Vinyl chloride	ug/L	28	20	36
Acetone	ug/L	4285	3000	6700
Bromodichloromethane	ug/L	<20	<20	<20
Bromomethane (Methyl bromide)	ug/L	<20	<20	<20
Chloromethane	ug/L	<20	<20	<20
Carbon disulfide	ug/L	<20	<20	<20
Dibromochloromethane	ug/L	<20	<20	<20
Styrene	ug/L	<20	<20	<20
Tetrachloroethene	ug/L	22	20	32
Trichloroethene	ug/L	32	22	39
Xylenes, Total	ug/L	505	370	620
Semi-Volatiles				
2-Chlorophenol	ug/L	303	10	500
Acenaphthene	ug/L	<113	<10	<250
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/L	<113	<10	<250
2-Nitroaniline	ug/L	563	50	1200
2-Chloroaniline	ug/L	23863	16	32000
2-Methylnaphthalene	ug/L	<113	<10	<250
2-Methylphenol (o-Cresol)	ug/L	<113	<10	<250
2,4-Dichlorophenol	ug/L	241	10	300
Acenaphthylene	ug/L	<113	<10	<250
3-Nitroaniline	ug/L	563	50	1200
2,4-Dimethylphenol	ug/L	<113	<10	<250
Anthracene	ug/L	<113	<10	<250
4,6-Dinitro-2-methylphenol	ug/L	563	50	1200
4-Chloroaniline	ug/L	14326	20	21000
4-Chloro-3-methylphenol	ug/L	<113	<10	<250
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/L	348	10	540
4-Nitroaniline	ug/L	<563	<50	<1200
2,4-Dinitrophenol	ug/L	<563	<50	<1200
2-Nitrophenol	ug/L	<113	<10	<250
Benzo(a)pyrene	ug/L	<113	<10	<250
4-Nitrophenol	ug/L	<563	<50	<1200

**TABLE 4. GROUNDWATER CHARACTERIZATION SUMMARY
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Aniline	ug/L	24474	3000	35000
Benzo(a)anthracene	ug/L	<113	<10	<250
Benzo(b)fluoranthene	ug/L	<113	<10	<250
Diethylphthalate	ug/L	<113	<10	<250
Pyridine	ug/L	<563	<50	<1200
2,4,5-Trichlorophenol	ug/L	<113	<10	<250
Benzo(g,h,i)perylene	ug/L	<113	<10	<250
Pentachlorophenol	ug/L	<563	<50	<1200
Phenol	ug/L	4103	10	6500
bis(2-Chloroethoxy)methane	ug/L	<113	<10	<250
2,4,6-Trichlorophenol	ug/L	<117	<10	<250
bis(2-Chloroethyl)ether	ug/L	<188	<10	<1600
bis(2-Ethylhexyl)phthalate	ug/L	<113	<10	<250
4-Bromophenylphenyl ether	ug/L	<113	<10	<250
Butylbenzylphthalate	ug/L	<113	<10	<250
2-Chloronaphthalene	ug/L	<113	<10	<250
4-Chlorophenylphenyl ether	ug/L	<113	<10	<250
Chrysene	ug/L	<113	<10	<250
Dibenzo(a,h)anthracene	ug/L	<113	<10	<250
1,2-Dichlorobenzene	ug/L	468	10	620
1,3-Dichlorobenzene	ug/L	<113	<10	<250
1,4-Dichlorobenzene	ug/L	392	10	510
3,3'-Dichlorobenzidine	ug/L	<226	<20	<500
Dimethylphthalate	ug/L	<113	<10	<250
Di-n-butylphthalate	ug/L	<113	<10	<250
2,4-Dinitrotoluene	ug/L	<113	<10	<250
2,6-Dinitrotoluene	ug/L	<113	<10	<250
Di-n-octylphthalate	ug/L	<113	<10	<250
1,2-Diphenylhydrazine	ug/L	<113	<10	<250
Fluoranthene	ug/L	<113	<10	<250
Fluorene	ug/L	<113	<10	<250
Hexachlorobenzene	ug/L	<113	<10	<250
Hexachlorobutadiene	ug/L	<113	<10	<250
Hexachlorocyclopentadiene	ug/L	<113	<10	<250
Hexachloroethane	ug/L	<113	<10	<250
INAeno(1,2,3-cd)pyrene	ug/L	<113	<10	<250
Isophorone	ug/L	<113	<10	<250
Naphthalene	ug/L	632	10	1500
Nitrobenzene	ug/L	<113	<10	<250
N-Nitrosodimethylamine	ug/L	<113	<10	<250
N-Nitrosodiphenylamine	ug/L	<113	<10	<250
Phenanthrene	ug/L	<113	<10	<250
Pyrene	ug/L	<113	<10	<250
1,2,4-Trichlorobenzene	ug/L	<113	<10	<250
Benzo(k)fluoranthene	ug/L	<113	<10	<250

**TABLE 4. GROUNDWATER CHARACTERIZATION SUMMARY
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Benzoic acid	ug/L	747	50	1200
Benzyl alcohol	ug/L	<113	<10	<250
Carbazole	ug/L	<113	<10	<250
Dibenzofuran	ug/L	<113	<10	<250
Dinoseb	ug/L	<113	<10	<250
N-Nitroso-di-n-propylamine	ug/L	<113	<10	<250
2-Nitrochlorobenzene	ug/L	16036	10	25000
3-Chloroaniline	ug/L	18751	10	37000
3-Nitrochlorobenzene	ug/L	1881	10	5000
4-Chloro-2,6-Dinitrophenol	ug/L	37020	200	100000
4-Chlorophenol	ug/L	3631	10	7100
4-Nitrochlorobenzene	ug/L	4666	10	7600
Benzidine	ug/L	14808	80	40000
Herbicides				
2,4,5-TP (Silvex)	ug/L	0.5	0.5	1
2,4-DB	ug/L	0.5	0.5	1
2,4-D	ug/L	67	55	84
2,4,5-T	ug/L	4.6	4.4	4.7
Pentachlorophenol	ug/L	2.8	2.1	3.3
Dalapon	ug/L	<126	<120	<240
Dicamba	ug/L	<1.3	<1.2	<2.4
Dichloroprop	ug/L	ND	ND	ND
MCPA[(4-chloro-2-methylphenoxy)-acetic acid]	ug/L	<126	<120	<240
MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/L	<126	<120	<240
PCBs				
Decachlorobiphenyl	ug/L	<0.5	<0.5	<0.5
Dichlorobiphenyl	ug/L	0.13	0.1	0.62
Heptachlorobiphenyl	ug/L	<0.3	<0.3	<0.3
Hexachlorobiphenyl	ug/L	<0.2	<0.2	<0.2
Monochlorobiphenyl	ug/L	0.14	0.1	0.32
Nonachlorobiphenyl	ug/L	<0.5	<0.5	<0.5
Octachlorobiphenyl	ug/L	<0.3	<0.3	<0.3
Pentachlorobiphenyl	ug/L	<0.2	<0.2	<0.2
Tetrachlorobiphenyl	ug/L	<0.2	<0.2	<0.2
Trichlorobiphenyl	ug/L	0.13	0.1	0.75
Aroclor-1242	ug/L	<1	<1	<1
Aroclor-1254	ug/L	<1	<1	<1
Aroclor-1221	ug/L	<2	<1	<2
Aroclor-1232	ug/L	<1	<1	<1
Aroclor-1248	ug/L	<1	<1	<1
Aroclor-1260	ug/L	<1	<1	<1
Aroclor-1016	ug/L	<1	<1	<1

**TABLE 4. GROUNDWATER CHARACTERIZATION SUMMARY
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Pesticides				
Aldrin	ug/L	<0.05	<0.03	<0.05
alpha-BHC	ug/L	<0.05	<0.03	<0.05
beta-BHC	ug/L	<0.05	<0.03	<0.05
gamma-BHC (LiNAane)	ug/L	<0.05	<0.03	<0.05
delta-BHC	ug/L	<0.05	<0.03	<0.05
Chlordane (technical)	ug/L	<0.5	<0.3	<0.5
4,4'-DDT	ug/L	<0.1	<0.1	<0.1
ENAsulfan I	ug/L	<0.05	<0.03	<0.05
ENAsulfan II	ug/L	<0.1	<0.1	<0.1
4,4'-DDE	ug/L	<0.1	<0.1	<0.1
4,4'-DDD	ug/L	<0.1	<0.1	<0.1
Dieldrin	ug/L	<0.1	<0.1	<0.1
ENAsulfan sulfate	ug/L	<0.1	<0.1	<0.1
ENArin	ug/L	<0.1	<0.1	<0.1
ENArin aldehyde	ug/L	<0.1	<0.1	<0.1
Heptachlor	ug/L	<0.05	<0.03	<0.05
Heptachlor epoxide	ug/L	<0.05	<0.03	<0.05
Toxaphene	ug/L	<5	<3	<5
alpha-Chlordane	ug/L	<0.05	<0.03	<0.05
ENArin ketone	ug/L	<0.1	<0.1	<0.1
gamma-Chlordane	ug/L	<0.05	<0.03	<0.05
Methoxychlor	ug/L	<0.5	<0.3	<0.5
Dioxins				
2,3,7,8-TCDD	ug/L	NA	NA	NA
Total TCDD	ug/L	1428	300	3700
1,2,3,7,8-PeCDD	ug/L	NA	NA	NA
Total PeCDD	ug/L	962	28	2000
1,2,3,4,7,8-HxCDD	ug/L	NA	NA	NA
1,2,3,6,7,8-HxCDD	ug/L	NA	NA	NA
1,2,3,7,8,9-HxCDD	ug/L	NA	NA	NA
Total HxCDD	ug/L	1567	1200	1800
1,2,3,4,6,7,8-HpCDD	ug/L	NA	NA	NA
Total HpCDD	ug/L	NA	NA	NA
OCDD	ug/L	NA	NA	NA
2,3,7,8-TCDF	ug/L	NA	NA	NA
Total TCDF	ug/L	NA	NA	NA
1,2,3,7,8-PeCDF	ug/L	NA	NA	NA
2,3,4,7,8-PeCDF	ug/L	NA	NA	NA
Total PeCDF	ug/L	NA	NA	NA
1,2,3,4,7,8-HxCDF	ug/L	NA	NA	NA
1,2,3,6,7,8-HxCDF	ug/L	NA	NA	NA
2,3,4,6,7,8-HxCDF	ug/L	NA	NA	NA
1,2,3,7,8,9-HxCDF	ug/L	NA	NA	NA
Total HxCDF	ug/L	NA	NA	NA

**TABLE 4. GROUNDWATER CHARACTERIZATION SUMMARY
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
1,2,3,4,6,7,8-HpCDF	ug/L	NA	NA	NA
1,2,3,4,7,8,9-HpCDF	ug/L	NA	NA	NA
Total HpCDF	ug/L	NA	NA	NA
OCDF	ug/L	NA	NA	NA

Notes:

- (a) If Average, Minimum, and Maximum are the same then there were no detections beyond the MDL.
- (b) If there are "<" before each number, then there were no detections above the MDL but the detection limits were different on some samples.
- (c) Parameters in **BOLD** are constituents that were detected at >1 ppb.

TABLE 5. EFFLUENT QUALITY ACHIEVED^(a)
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS

PARAMETER	UNITS	RESULT ^(b)
Miscellaneous		
TKN	mg/L	9.4
Ammonia	mg/L	9.0
BOD	mg/L	30
Metals		
Silver	mg/L	ND
Aluminum	mg/L	ND
Arsenic	mg/L	ND
Barium	mg/L	0.376
Beryllium	mg/L	ND
Calcium	mg/L	ND
Cadmium	mg/L	ND
Cobalt	mg/L	ND
Chromium	mg/L	ND
Copper	mg/L	ND
Iron	mg/L	18
Mercury	mg/L	ND
Potassium	mg/L	ND
Magnesium	mg/L	ND
Manganese	mg/L	2.9
Sodium	mg/L	ND
Nickel	mg/L	ND
Lead	mg/L	ND
Antimony	mg/L	ND
Selenium	mg/L	ND
Thallium	mg/L	ND
Vanadium	mg/L	ND
Zinc	mg/L	0.04
Volatiles		
1,1-Dichloroethene	ug/L	ND
1,2-Dichloroethene (total)	ug/L	ND
2-Butanone (MEK)	ug/L	ND
Benzene	ug/L	ND
4-Methyl-2-pentanone (MIBK)	ug/L	ND
Acrolein	ug/L	ND
Acrylonitrile	ug/L	ND
Bromoform	ug/L	ND
Carbon tetrachloride	ug/L	ND
Chlorobenzene	ug/L	ND

TABLE 5. EFFLUENT QUALITY ACHIEVED^(a)
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS

PARAMETER	UNITS	RESULT ^(b)
cis-1,3-Dichloropropene	ug/L	ND
trans-1,3-Dichloropropene	ug/L	ND
Chloroethane	ug/L	ND
2-Chloroethylvinyl ether	ug/L	ND
Chloroform	ug/L	ND
1,1-Dichloroethane	ug/L	ND
1,2-Dichloroethane	ug/L	ND
1,2-Dichloropropane	ug/L	ND
1,3-Dichloropropene (total)	ug/L	ND
Ethylbenzene	ug/L	ND
Methylene chloride (Dichloromethane)	ug/L	2.9
1,1,2,2-Tetrachloroethane	ug/L	ND
Toluene	ug/L	0.42
1,1,1-Trichloroethane	ug/L	ND
1,1,2-Trichloroethane	ug/L	ND
Vinyl chloride	ug/L	ND
Bromodichloromethane	ug/L	ND
Bromomethane (Methyl bromide)	ug/L	ND
Chloromethane	ug/L	ND
Carbon disulfide	ug/L	ND
Dibromochloromethane	ug/L	ND
Tetrachloroethene	ug/L	ND
Trichloroethene	ug/L	ND
m and p-Xylene	ug/L	ND
o-Xylene	ug/L	ND
Xylenes, Total	ug/L	ND
Semi-Volatiles		
2-Chlorophenol	ug/L	ND
Acenaphthene	ug/L	ND
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/L	ND
2-Nitroaniline	ug/L	ND
2-Chloroaniline	ug/L	1
2-Methylphenol (o-Cresol)	ug/L	ND
2,4-Dichlorophenol	ug/L	ND
Acenaphthylene	ug/L	ND
2,4-Dimethylphenol	ug/L	ND
Anthracene	ug/L	ND
4,6-Dinitro-2-methylphenol	ug/L	ND
4-Chloroaniline	ug/L	ND
4-Chloro-3-methylphenol	ug/L	ND
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/L	ND

**TABLE 5. EFFLUENT QUALITY ACHIEVED^(a)
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS**

PARAMETER	UNITS	RESULT ^(b)
4-Nitroaniline	ug/L	ND
2,4-Dinitrophenol	ug/L	ND
2-Nitrophenol	ug/L	ND
Benzo(a)pyrene	ug/L	ND
4-Nitrophenol	ug/L	ND
Aniline	ug/L	5
Benzo(a)anthracene	ug/L	ND
Benzo(b)fluoranthene	ug/L	ND
Diethylphthalate	ug/L	ND
2,4,5-Trichlorophenol	ug/L	ND
Benzo(g,h,i)perylene	ug/L	ND
Pentachlorophenol	ug/L	ND
Phenol	ug/L	ND
bis(2-Chloroethoxy)methane	ug/L	ND
2,4,6-Trichlorophenol	ug/L	ND
bis(2-Chloroethyl)ether	ug/L	ND
bis(2-Ethylhexyl)phthalate	ug/L	ND
4-Bromophenylphenyl ether	ug/L	ND
Butylbenzylphthalate	ug/L	ND
2-Chloronaphthalene	ug/L	ND
4-Chlorophenylphenyl ether	ug/L	ND
Chrysene	ug/L	ND
Dibenzo(a,h)anthracene	ug/L	ND
1,2-Dichlorobenzene	ug/L	ND
1,3-Dichlorobenzene	ug/L	ND
1,4-Dichlorobenzene	ug/L	ND
3,3'-Dichlorobenzidine	ug/L	ND
Dimethylphthalate	ug/L	ND
2,4-Dinitrotoluene	ug/L	ND
2,6-Dinitrotoluene	ug/L	ND
Di-n-octylphthalate	ug/L	ND
1,2-Diphenylhydrazine	ug/L	ND
Fluoranthene	ug/L	ND
Fluorene	ug/L	ND
Hexachlorobenzene	ug/L	ND
Hexachlorobutadiene	ug/L	ND
Hexachlorocyclopentadiene	ug/L	ND
Hexachloroethane	ug/L	ND
Indeno(1,2,3-cd)pyrene	ug/L	ND
Isophorone	ug/L	ND
Naphthalene	ug/L	ND

TABLE 5. EFFLUENT QUALITY ACHIEVED^(a)
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS

PARAMETER	UNITS	RESULT ^(b)
Nitrobenzene	ug/L	ND
N-Nitrosodimethylamine	ug/L	ND
N-Nitrosodiphenylamine	ug/L	ND
Phenanthrene	ug/L	ND
Pyrene	ug/L	ND
1,2,4-Trichlorobenzene	ug/L	ND
Benzo(k)fluoranthene	ug/L	ND
Dinoseb	ug/L	ND
N-Nitroso-di-n-propylamine	ug/L	ND
2-Nitrochlorobenzene	ug/L	ND
3-Chloroaniline	ug/L	ND
3-Nitrochlorobenzene	ug/L	ND
4-Chloro-2,6-Dinitrophenol	ug/L	ND
4-Nitrochlorobenzene	ug/L	ND
Benzidine	ug/L	ND
Herbicides		
2,4,5-TP (Silvex)	ug/L	ND
2,4-D	ug/L	ND
2,4,5-T	ug/L	ND
Pentachlorophenol	ug/L	ND
Dalapon	ug/L	ND
PCBs		
Aroclor-1242	ug/L	ND
Aroclor-1254	ug/L	ND
Aroclor-1221	ug/L	ND
Aroclor-1232	ug/L	ND
Aroclor-1248	ug/L	ND
Aroclor-1260	ug/L	ND
Aroclor-1016	ug/L	ND
Pesticides		
Aldrin	ug/L	ND
alpha-BHC	ug/L	ND
beta-BHC	ug/L	ND
gamma-BHC (Lindane)	ug/L	ND
delta-BHC	ug/L	ND
Chlordane (technical)	ug/L	ND
4,4'-DDT	ug/L	ND
Endosulfan I	ug/L	ND
Endosulfan II	ug/L	ND
4,4'-DDE	ug/L	ND
4,4'-DDD	ug/L	ND

TABLE 5. EFFLUENT QUALITY ACHIEVED^(a)
MAY 2003 PUMP DEMONSTRATION TEST
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS

PARAMETER	UNITS	RESULT ^(b)
Dieldrin	ug/L	ND
Endosulfan sulfate	ug/L	ND
Endrin	ug/L	ND
Endrin aldehyde	ug/L	ND
Heptachlor	ug/L	ND
Heptachlor epoxide	ug/L	ND
Toxaphene	ug/L	ND
Methoxychlor	ug/L	ND

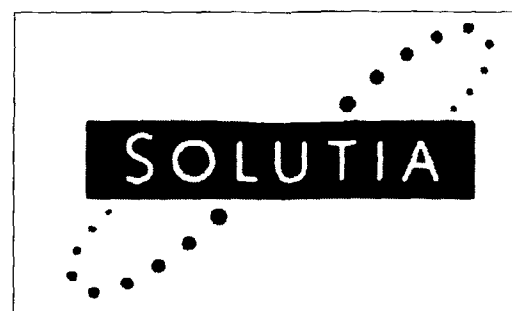
Notes:

(a) Based on ABRTF effluent analysis after lag column May 21, 2003.

(b) ND = Non Detect

SOLUTIA KRUMMRICH, INC.

SAUGET, ILLINOIS



CARBON TREATMENT SYSTEM

JULY 2003

<u>DRAWING NO.</u>	<u>DESCRIPTION</u>
LEGEND	DRAWING SYMBOLS LEGEND
PFD-1	PROCESS FLOW DIAGRAM
PID-1	CARBON TREATMENT SYSTEM UNITS 1 & 2
PID-2	CARBON TREATMENT SYSTEM UNITS 3 & 4
PID-3	CARBON TREATMENT BACKFLUSH SUPPLY & TRANSFER UTILITIES
C-01	CARBON TREATMENT SYSTEM SITE PLAN
PP-01	MAJOR PIPING PLAN
PP-02	INFLUENT & EFFLUENT CONNECTION DETAILS
PP-03	HOSE CONNECTION DETAILS
SS-01	BACKFLUSH SUPPLY TANK DETAILS
E-01	ELECTRICAL POWER LAYOUT
E-02	PANEL SCHEDULES & RISER DIAGRAM



THE **ADVENT** GROUP, INC

Nashville, Tennessee

ADVENT PROJECT NO. 02691

LINE SYMBOLS	
	GATE VALVE
	NORMAL CLOSED VALVE
	BALL VALVE
	PLUG VALVE
	BUTTERFLY VALVE
	CHECK VALVE
	GLOBE VALVE
	PINCH VALVE
	DIAPHRAGM VALVE
	3-WAY VALVE
	NEEDLE VALVE
	CONTROL VALVE
	CONTROL VALVE WITH POSITIONER
	MOTOR CONTROL VALVE
	SOLENOID OPERATED VALVE
	CONTROL VALVE-BUTTERFLY
	AIR ACTUATED VALVE-BUTTERFLY
	PRESSURE RELIEF VALVE
	VACUUM RELIEF VALVE
	BACK PRESSURE CONTROL VALVE
	PRESSURE REGULATING VALVE
	STRAINER
	HOSE CONNECTION
	FLEXIBLE HOSE
	EXPANSION JOINT
	REDUCING EXPANSION JOINT
	REDUCER
	BLIND FLANGE
	CHEMICAL SEAL
	ORIFICE
	TURBINE METER
	MAGNETIC FLOW METER
	DOPPLER-TYPE FLOW METER
	PITOT TUBE OR ANNUBAR FLOW ELEMENT
	ROTOMETER
	WEIR
	FLUME
	BOUNDARY OF VENDOR PACKAGE
	SAMPLE OR DRAIN VALVE

INSTRUMENTATION LEGEND				
FIRST LETTER		SUCCEEDING-LETTERS		
MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A ANALYSIS		ALARM		
B BURNER, COMBUSTION				
C			CONTROL	
D	DIFFERENTIAL			
E VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F FLOW RATE	RATIO (FRACTION)			
G		GLASS, VIEWING DEVICE		
H HAND				HIGH
I CURRENT (ELECTRICAL)		INDICATE		
J POWER	SCAN			
K TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L LEVEL		LIGHT		LOW
M	MOMENTARY			MIDDLE INTERMEDIATE
N				
O		ORIFICE, RESTRICTION		
P PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q QUANTITY	INTEGRATE, TOTALIZE			
R RADIATION		RECORD		
S SPEED, FREQUENCY	SAFETY		SWITCH	
T TEMPERATURE			TRANSMIT	
U MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W WEIGHT, FORCE		WELL		
X UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y EVENT, STATE OR PRESENCE	Y AXIS	RELAY, COMPUTE, CONVERT		
Z POSITION, DIMENSION	Z AXIS	DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT		

UTILITY SYMBOLS	
PA	PLANT AIR
IA	INSTRUMENT AIR
SW	SERVICE WATER
NG	NATURAL GAS
PW	POTABLE WATER

PIPE ABBREVIATIONS	
CS	CARBON STEEL
PVC	POLYVINYL CHLORIDE
SSA	STAINLESS STEEL 304
SSB	STAINLESS STEEL 316
HDPE	HIGH DENSITY POLYETHYLENE
DI	DUCTILE IRON
GS	GALVANIZED STEEL
CU	COPPER
VC	VITROUS CLAY

EQUIPMENT SYMBOLS			
	CENTRIFUGAL PUMP		FLOCCULATOR
	DOUBLE DIAPHRAGM PUMP		PROGRESSIVE CAVITY PUMP
	DIAPHRAGM METERING PUMP		CENTRIFUGAL BLOWER
	POSITIVE DISPLACEMENT BLOWER		COMPRESSOR
	AGITATOR		

INSTRUMENT SYMBOLS	
	INSTRUMENT (LOCAL MOUNTED)
	INSTRUMENT (VENDOR PROVIDED)
	INSTRUMENT PANEL MOUNTED
	INSIDE INSTRUMENT PANEL
	PROGRAMMABLE LOGIC CONTROLLER
	INSTRUMENT PANEL MOUNTED SHARED DISPLAY (DCS)
	COMPUTER FUNCTION
	PILOT LIGHT
	UNDEFINED ELECTRICAL INTERLOCK
	FUNCTION BLOCK
	CONNECTION TO PROCESS OR MECHANICAL LINK
	PNEUMATIC SIGNAL
	ELECTRIC SIGNAL
	ELECTRIC BINARY SIGNAL
	SONIC SIGNAL
	HYDRAULIC SIGNAL

EQUIPMENT DESIGNATION	
A	AGITATOR
B	BLOWER
C	COMPRESSOR
F	FILTER
H	HEATER
M	MIXER (IN LINE)
P	PUMP
S	SEPARATOR
T	TANK
SP	SPECIAL EQT.
V	VESSEL
HE	HEATING ELEMENT

INSULATION CODE	
ST	STEAM TRACED
HC	HEAT CONSERVATION
PP	PERSONNEL PROTECTION
ET	ELECTRICAL TRACED
GLY	GLYCOL TRACED
NI	NOT INSULATED
UG	UNDERGROUND
AG	ABOVE GROUND

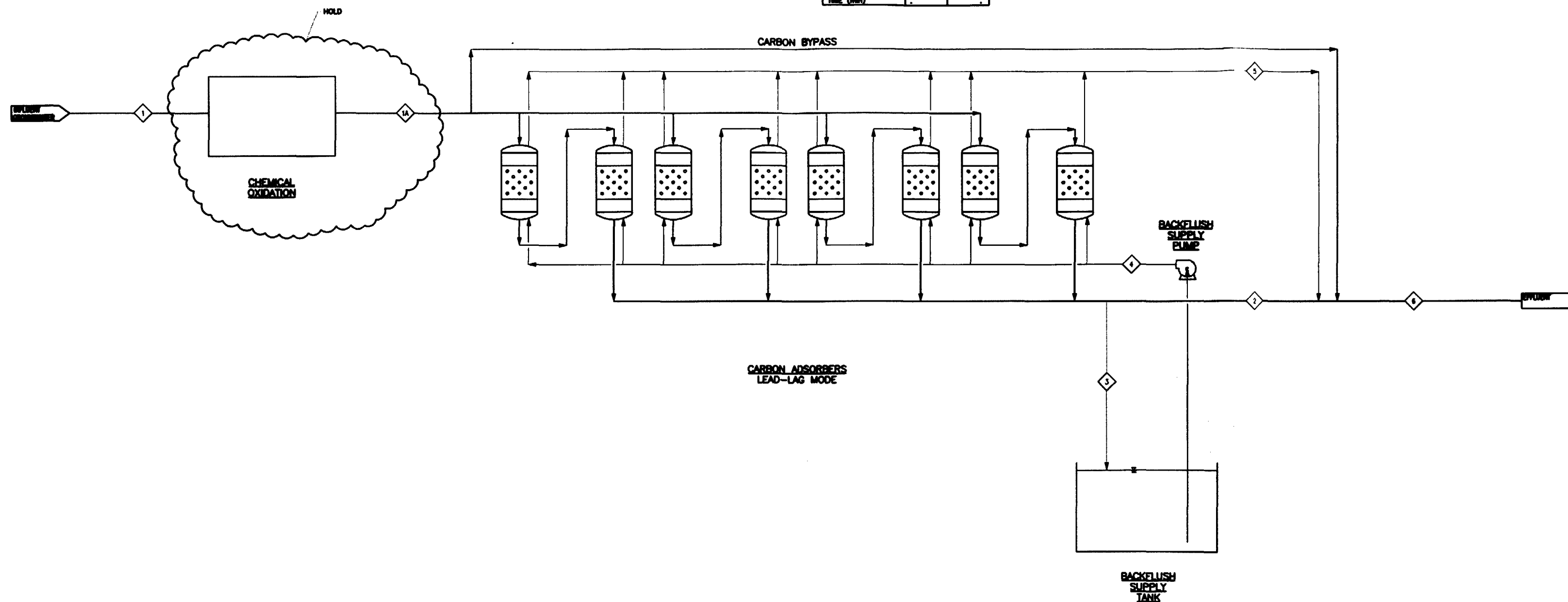
PIPING	
	PRIMARY
	SECONDARY
	UTILITY
	EXISTING
	INSULATED
	INSULATED & TRACED
LINE NUMBERING KEY	

SERVICE CODE			
BR	BACKFLUSH RETURN	CF	CARBON FEED
BS	BACKFLUSH SUPPLY	GW	GROUNDWATER
CA	COMPRESSED AIR	SW	SPRAY WATER
CE	CARBON EFFLUENT	TW	TRAILER WATER

D	CONTINGENCY PLAN	7/23/03	CSR	WWL
C	PRE-FINAL DESIGN	11/19/02	CSR	WWL
 THE ADVENT GROUP, INC. Nashville, Tennessee				
DRAWING SYMBOLS LEGEND				
SOLUTIA KRUMMRICH SAUGET, IL				
RLR	11/14/02		CSR	11/14/02
TL	11/14/02			
1/4"=1'-0"		1	1	D
DATA\02691\CAD\C.L\LEGEND.DWG				
02691	LEGEND			D

BACKFLUSH SUPPLY TANK	
NUMBER OF UNITS	1
CAPACITY (gal.)	12,000
MOVING: NONE	

CARBON ADSORPTION	
NUMBER OF DUAL MODULE UNITS	4
TOTAL SURFACE AREA OF ALL LEAD COLUMNS (ft ²)	314
HYDRAULIC LOADING RATE (gpm/ft ²)	AVERAGE 2.5 DESIGN 4.2
LEAD/LAG OPERATION	
TOTAL CARBON CONTACT TIME (min)	AVERAGE 48 DESIGN 30



PROCESS MASS AND FLOW BALANCE							
PARAMETERS	1 INFLUENT GROUNDWATER	1A OXIDATION EFFLUENT	2 COLUMN EFFLUENT	3 COLUMN EFFLUENT TO BACKFLUSH SUPPLY TANK	4 BACKFLUSH FEED	5 BACKFLUSH RETURN	6 FINAL EFFLUENT
FLOW	CONTINUOUS 1,000	CONTINUOUS 1,000	CONTINUOUS 1,000	INTERMITTENT 1,000	INTERMITTENT 225	INTERMITTENT 225	CONTINUOUS 1,000
TSS	13	13	2	2	2	200	2
TOC	196	196	24	24	5	540	24
	142	<121	18	18	18	18	18
	1,705	<1,458	182	182	43	43	182

NOTE: FINAL EFFLUENT TSS CONCENTRATION WILL INCREASE TO 38 mg/L DURING BACKFLUSH DUE TO CARBON FINES.

CAD NAME: S:\ARCH\00001\001\001\001-1.DWG				DRAWING SIZE: D	
BY	DATE	BY	DATE		
DRAWN R.L.R.	10/8/02	CHKD T.L.	10/8/02		
SCALE: N.T.S.					

PROCESS FLOW DIAGRAM
CARBON TREATMENT SYSTEM

SOLUTIA KRUMMRICH
SAUGET, IL

CONTRACT NO. 02691	DRAWING NO. PFD-1	REV. D
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D	CONTINGENCY PLAN	7/23/03	C.S.R.	R.L.R.
C	PRE-FINAL DESIGN	11/8/02	T.L.	R.L.R.
REV	DESCRIPTION	DATE	APPR BY	MADE BY
REVISIONS				

AD
THE ADVENT GROUP, INC.
NASHVILLE, TENNESSEE

V-1 A/B
CARBON ADSORBERS
SIZE 10'-0" x 8'-0" BED DEPTH
FILTER AREA PER COLUMN = 78 SF
MAT'L OF CONST: CS W/VINYL ESTER LINING

V-2 A/B
CARBON ADSORBERS
SIZE 10'-0" x 8'-0" BED DEPTH
FILTER AREA PER COLUMN = 78 SF
MAT'L OF CONST: CS W/VINYL ESTER LINING

INFLUENT GW FROM
EXTRACTION WELLS

12"-HDPE-GW-0101

HDPE DI

GW-V-01 GW-V-04

GW-V-02 GW-V-01

8"-DI-GW-0113

CARBON BYPASS
DWG. PID-2

(NOTE 3)

CF-V-05

8"-CS-GW-0114

CF-V-03

3/4"

CF-V-04

CARBON FEED
DWG. PID-2

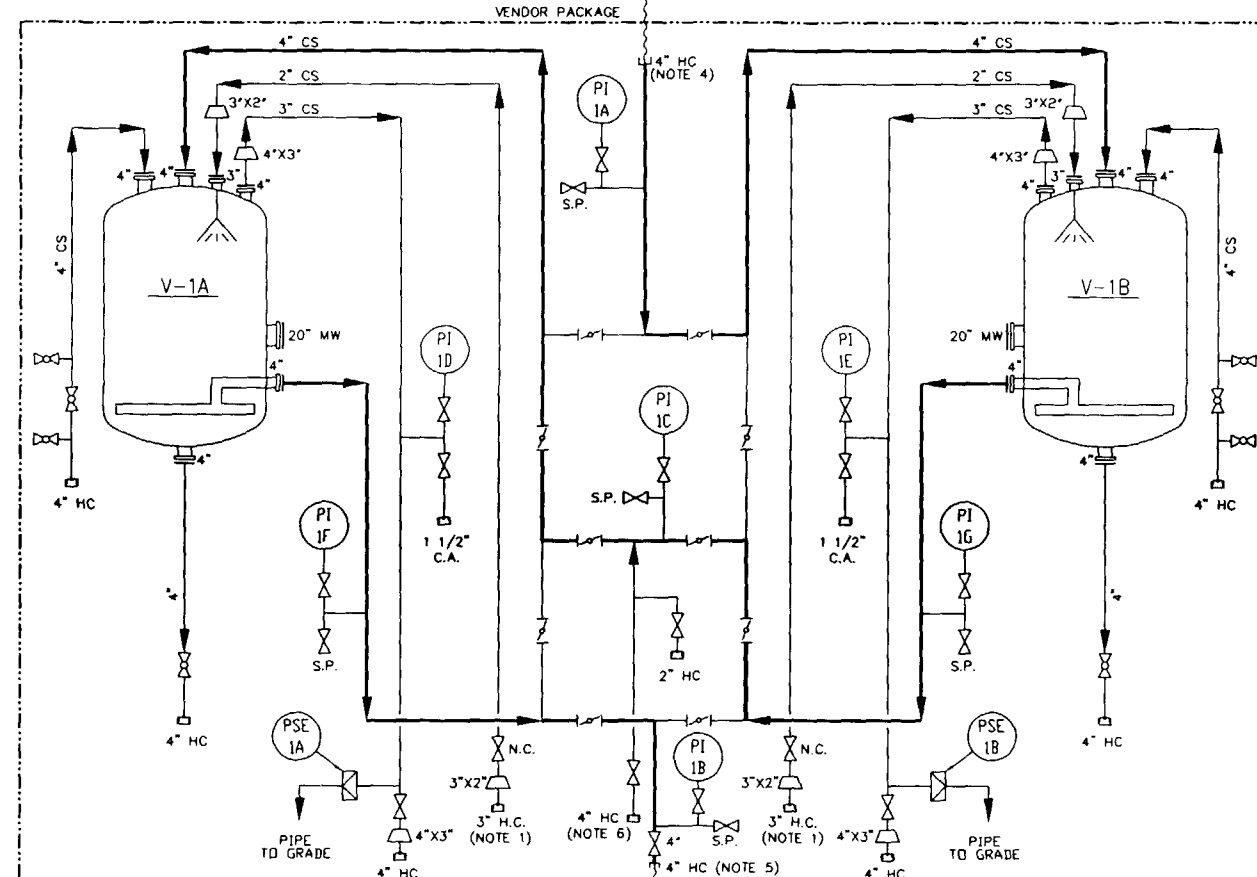
8"-CS-CF-0102

FIG 1

CF-V-06

4"-CS-CF-0103

VENDOR PACKAGE



4"-CS-CE-0105

CE-V-10

8"-CS-CE-0107

4" HC

4"X3"

3"-CS-BS-0108

4" HC

4"X3"

3"-CS-BS-0109

4" HC

4"X3"

3"-CS-BS-0110

4" HC

4"X3"

3"-CS-BS-0111

4" HC

4"X3"

3"-CS-BS-0112

4" HC

4"X3"

3"-CS-BS-0113

4" HC

4"X3"

3"-CS-BS-0114

4" HC

4"X3"

3"-CS-BS-0115

4" HC

4"X3"

3"-CS-BS-0116

4" HC

4"X3"

3"-CS-BS-0117

4" HC

4"X3"

3"-CS-BS-0118

4" HC

4"X3"

3"-CS-BS-0119

NOTES:

- HOSE CONNECTION FROM P-2 DISCHARGE DURING CARBON TRANSFER.
- PRIMARY FLOW SHOWN WITH COLUMN "B" IN LEAD POSITION AND COLUMN "A" IN LAG POSITION.
- CONNECTIONS FOR FUTURE FILTRATION SYSTEM (IF REQUIRED).
- ADSORBER HOSE CONNECTION FOR CARBON INFLUENT.
- ADSORBER HOSE CONNECTION FOR CARBON EFFLUENT.
- ADSORBER HOSE CONNECTION FOR BACKFLUSH SUPPLY.
- ADSORBER HOSE CONNECTION FOR BACKFLUSH RETURN.

3"-CS-BR-0110

4" HC

4"X3"

3"-CS-BS-0112

4" HC

4"X3"

3"-CS-BS-0114

4" HC

4"X3"

3"-CS-BS-0116

4" HC

4"X3"

3"-CS-BS-0118

4" HC

4"X3"

3"-CS-BS-0120

4" HC

4"X3"

3"-CS-BS-0122

4" HC

4"X3"

3"-CS-BS-0124

4" HC

4"X3"

3"-CS-BS-0126

4" HC

4"X3"

3"-CS-BS-0128

4" HC

4"X3"

3"-CS-BS-0130

4" HC

4"X3"

3"-CS-BS-0132

4" HC

4"X3"

3"-CS-BS-0134

4" HC

4"X3"

3"-CS-BS-0136

4" HC

4"X3"

3"-CS-BS-0138

4" HC

4"X3"

3"-CS-BS-0140

4" HC

4"X3"

3"-CS-BS-0142

4" HC

4"X3"

3"-CS-BS-0144

4" HC

4"X3"

3"-CS-BS-0146

4" HC

4"X3"

3"-CS-BS-0148

4" HC

4"X3"

3"-CS-BS-0150

4" HC

4"X3"

3"-CS-BS-0152

4" HC

4"X3"

3"-CS-BS-0154

4" HC

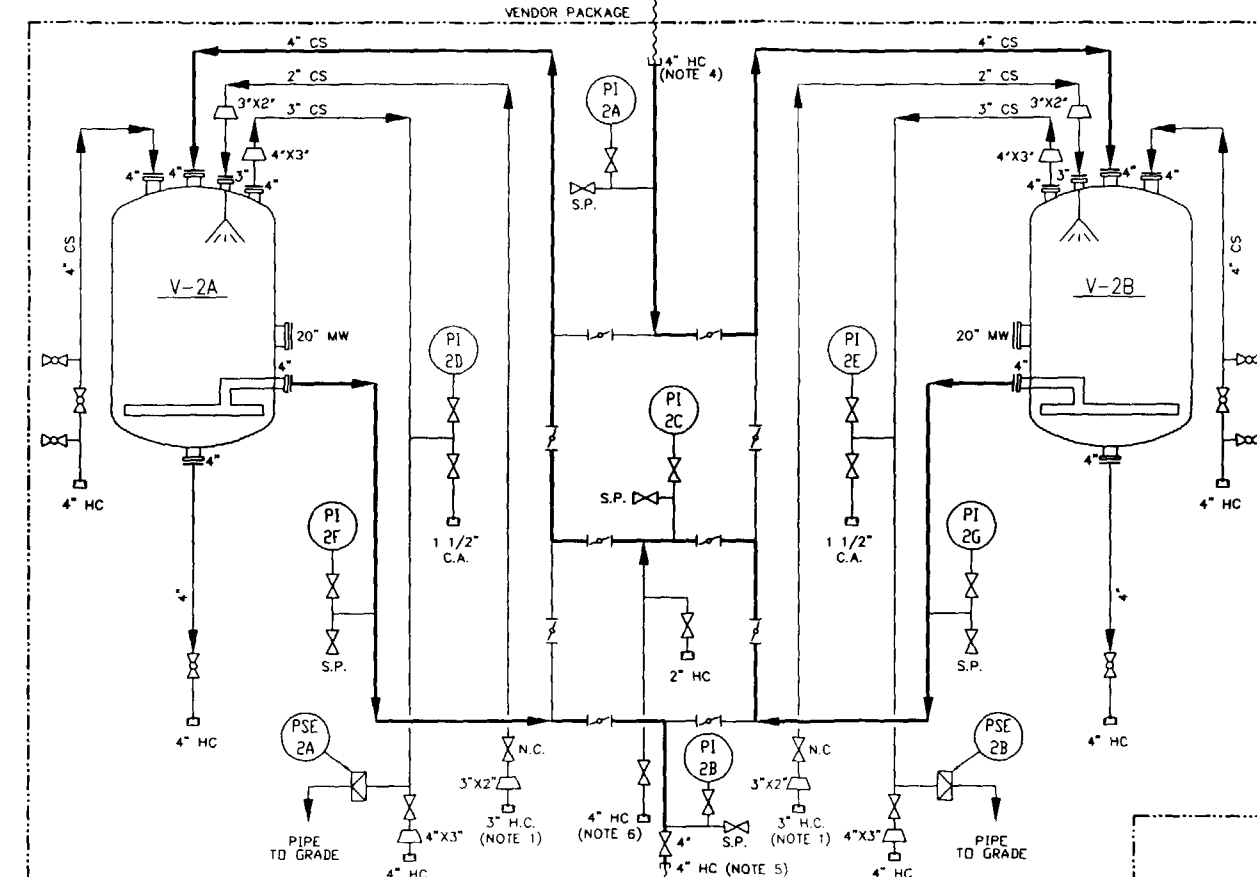
4"X3"

3"-CS-BS-0156

4" HC

4"X3"

3"-CS-BS-0158



4"-CS-CE-0106

CE-V-11

CARBON EFFLUENT
DWG. PID-3

BACKFLUSH SUPPLY
DWG. PID-3

BACKFLUSH RETURN
DWG. PID-2

DATE	BY	DATE	BY
10/9/02	R.L.R.	10/9/02	C.S.R.
10/9/02	T.L.		
N.T.S.			

THE ADVENT GROUP, INC.
NASHVILLE, TENNESSEE

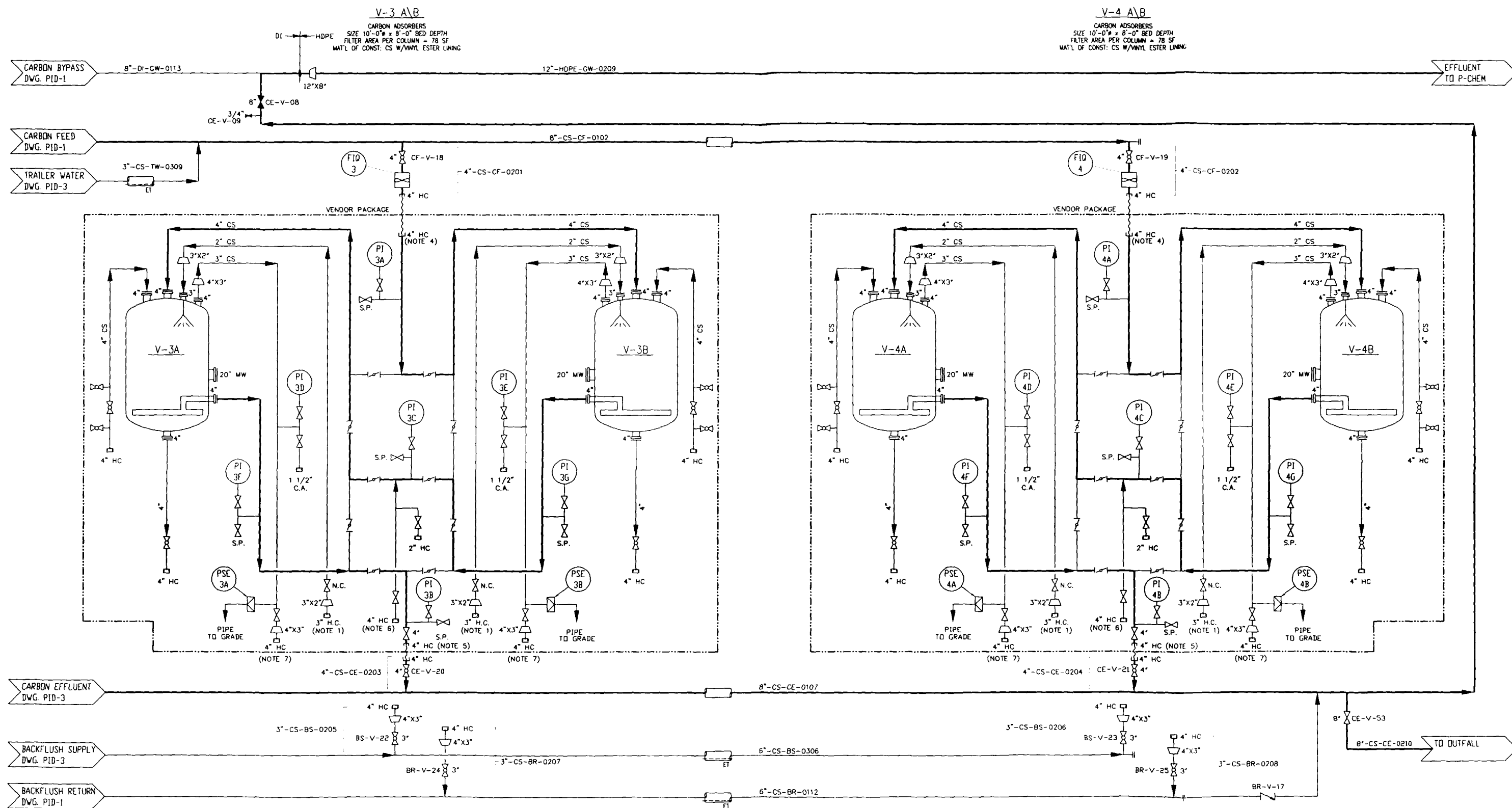
CARBON TREATMENT SYSTEM
UNITS 1 & 2

SOLUTIA KRUMMRICH
SAUGET, IL

CONTRACT NO. 02691
DRAWING NO. PID-1
REV. D

NO.	DESCRIPTION	DATE	APP'D.	DATE
D	CONTINGENCY PLAN	7/23/03	C.S.R.	R.L.R.
C	PRE-FINAL DESIGN	11/19/02	T.L.	R.L.R.
P	DESIGN			

REVISIONS



- NOTES:
- HOSE CONNECTION FROM P-2 DISCHARGE DURING CARBON TRANSFER.
 - PRIMARY FLOW SHOWN WITH COLUMN "B" IN LEAD POSITION AND COLUMN "A" IN LAG POSITION.
 - CONNECTIONS FOR FUTURE FILTRATION SYSTEM (IF REQUIRED).
 - ADSORBER HOSE CONNECTION FOR CARBON INFLUENT.
 - ADSORBER HOSE CONNECTION FOR CARBON EFFLUENT.
 - ADSORBER HOSE CONNECTION FOR BACKFLUSH SUPPLY.
 - ADSORBER HOSE CONNECTION FOR BACKFLUSH RETURN.

D	CONTINGENCY PLAN	7/23/03	C.S.R.	R.L.R.
C	PRE-FINAL DESIGN	11/19/02	T.L.	R.L.R.
PE	DESIGN	DATE	APP	MADE

DATE	BY	DATE	BY	DATE	BY
10/9/02	R.L.R.	10/9/02	C.S.R.	10/9/02	
10/9/02	T.L.				
	N.T.S.				

CARBON TREATMENT SYSTEM UNITS 3 & 4		
SOLUTIA KRUMMRICH SAUGET, IL		
CONTRACT NO.	DRAWING NO.	REV.
02691	PID-2	D

T-1
BACKFLUSH HOLDING TANK
14' Ø X 12' H
MATERIAL OF CONST. CARBON STEEL

P-1
BACKFLUSH SUPPLY PUMP
225 GPM @ 15' TDH
3 HP
480 V, 3Ø

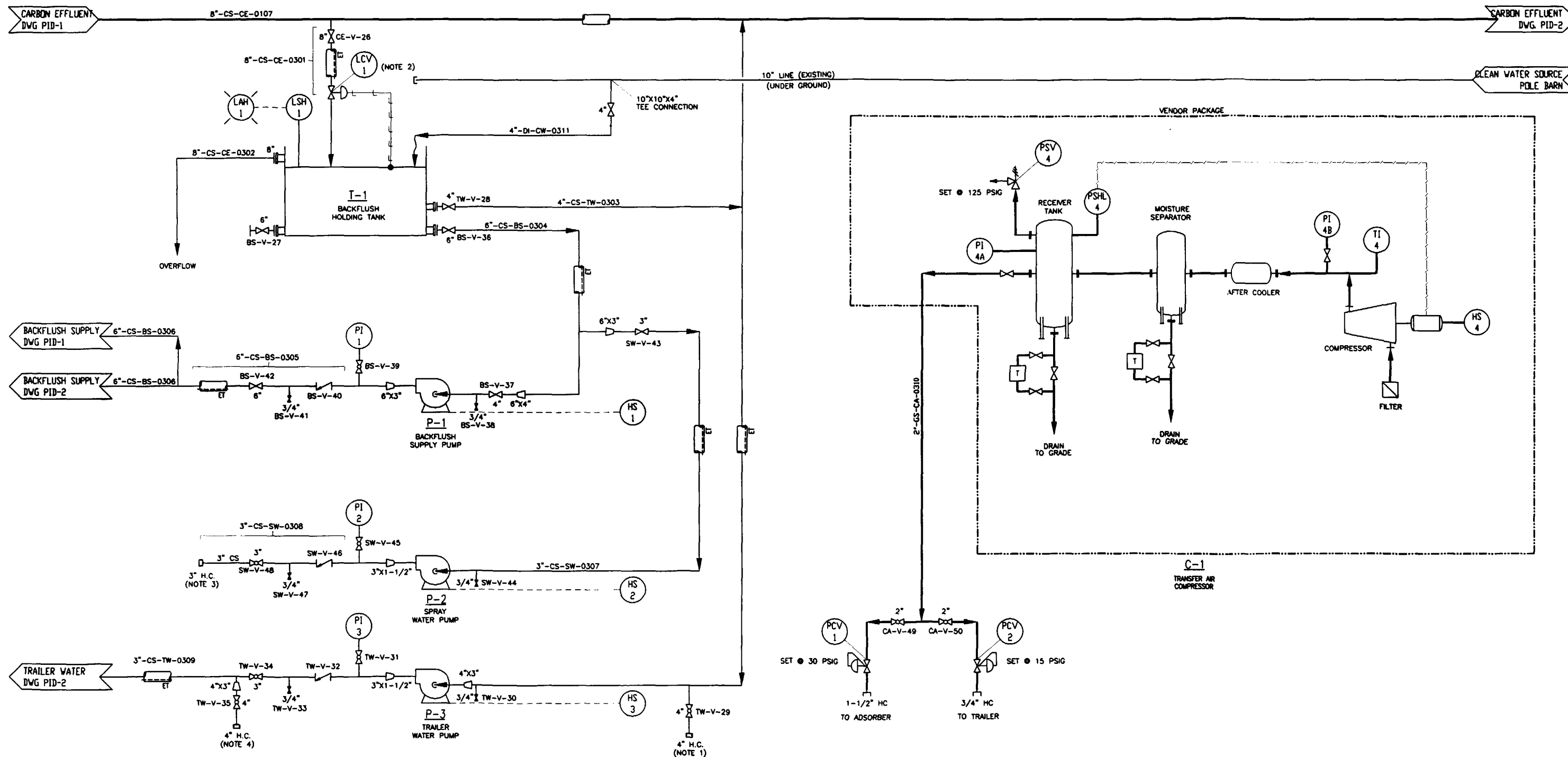
P-2
SPRAY WATER PUMP
100 GPM @ 180' TDH
10 HP
480 V, 3Ø

P-3
TRAILER WATER PUMP
100 GPM @ 51' TDH
5 HP
480 V, 3Ø

C-1
TRANSFER AIR COMPRESSOR
CAPACITY: 40 CFM
PRESSURE: 100 PSIG
10 HP

NOTES:

- HOSE CONNECTION TO P-3 SUCTION FROM CARBON TRANSFER TRAILER.
- VALVE SET TO MAINTAIN TANK LEVEL AT 10'-6".
- HOSE CONNECTION FROM P-2 DISCHARGE TO SPRAY WATER LINE FOR VESSEL UNDERGOING CHANGEOUT.
- HOSE CONNECTION FROM P-3 DISCHARGE TO CARBON TRANSFER TRAILER.



CAD NAME: L:\DATA\00001\CAD\PID-2.DWG				DRAWING SIZE: D	
BY	DATE	BY	DATE	BY	DATE
WWL	10-10-02	CSR	10-10-02		
CHKD.	TL				
SCALE: NONE					

CARBON TREATMENT
BACKFLUSH SUPPLY &
TRANSFER UTILITIES

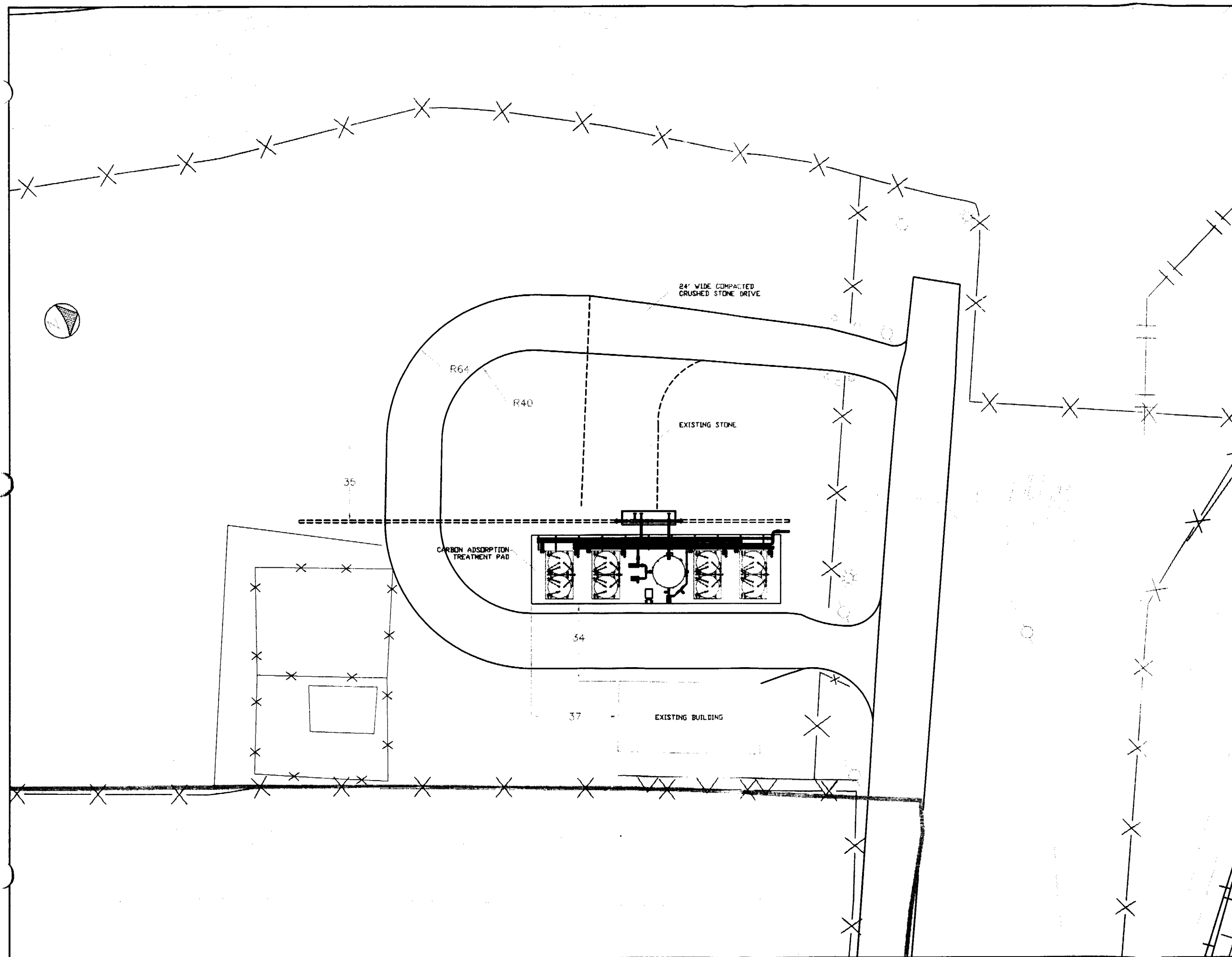
SOLUTIA KRUMMRICH

SAUGET, IL

CONTRACT NO.	DRAWING NO.	REV.
02691	PID-3	D

D	CONTINGENCY PLAN	7/23/03	CSR	RLR
C	PRE-FINAL DESIGN	11/19/02	CSR	RLR
REV	DESCRIPTION	DATE	APP. BY	MADE BY
REVISIONS				

THE ADVENT GROUP, INC.
NASHVILLE, TENNESSEE



D	CONTINGENCY PLAN	7/23/03	CSR	RLR
C	PRE-FINAL DESIGN	11/18/02	CSR	RLR
REV	DESCRIPTION	DATE	APPR BY	DATE

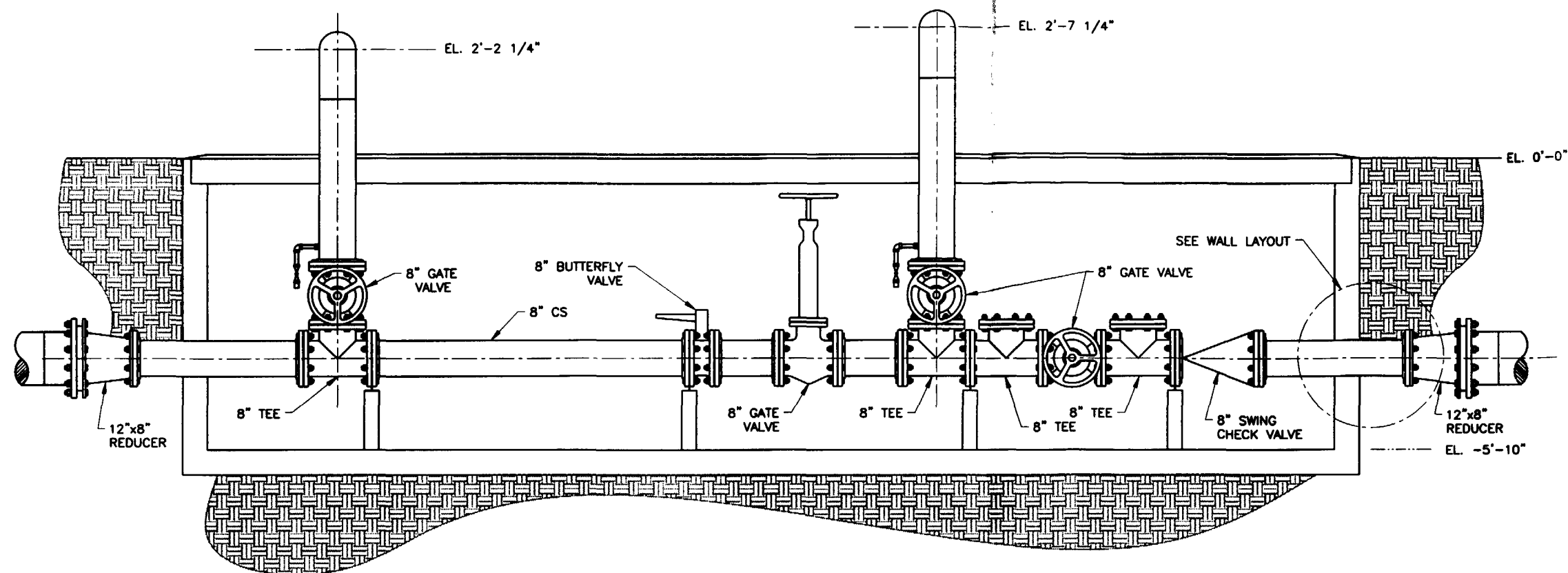
REVISIONS

THE ADVENT GROUP, INC.
Nashville, Tennessee

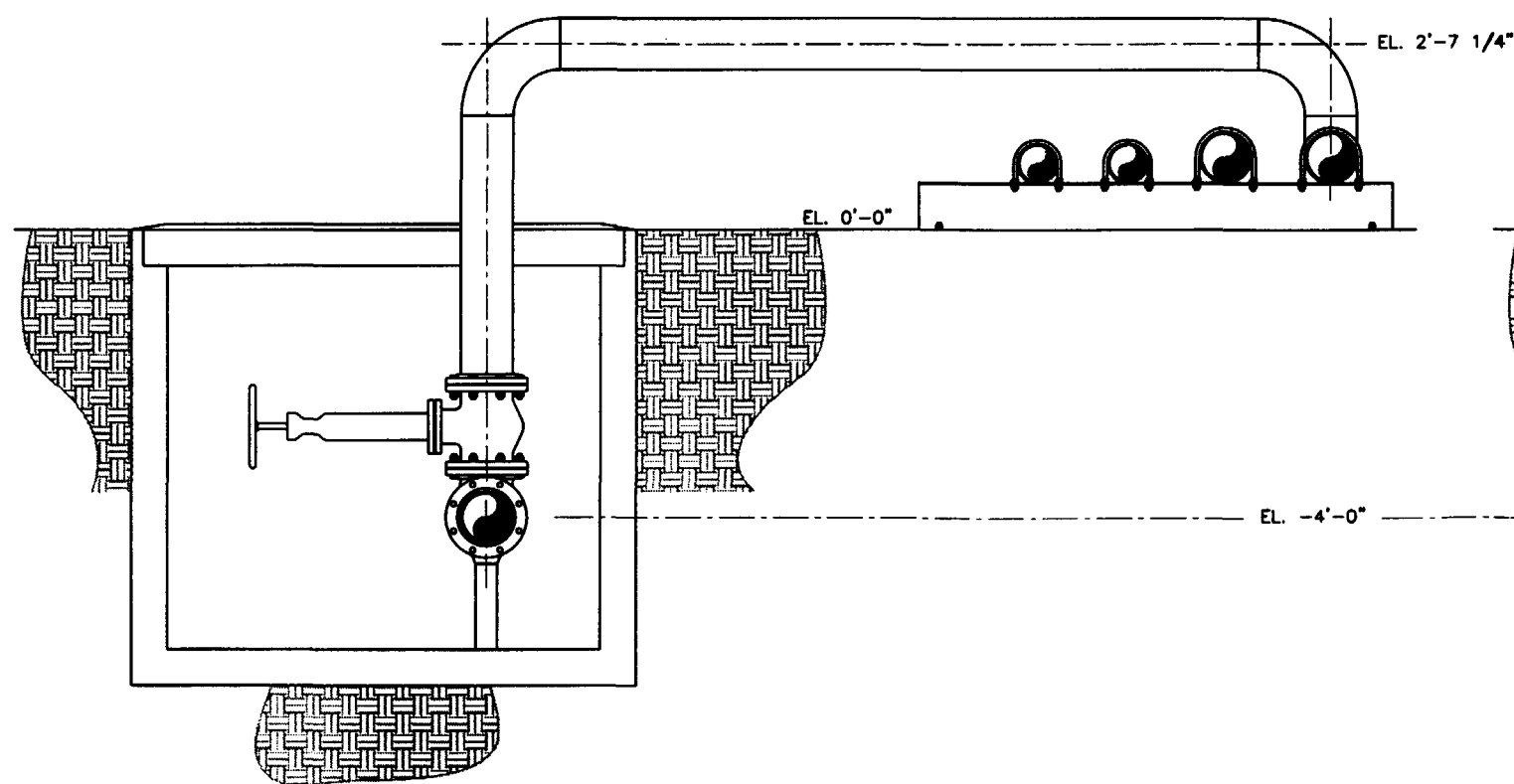
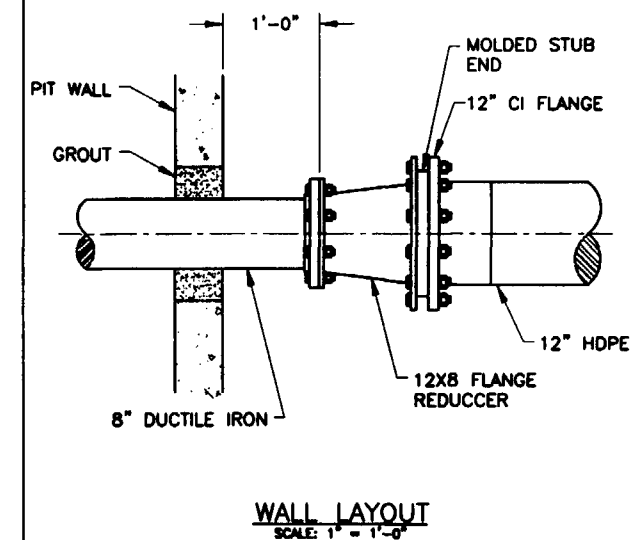
SITE PLAN

SOLUTIA KRUMMRICH
SAUGET, IL

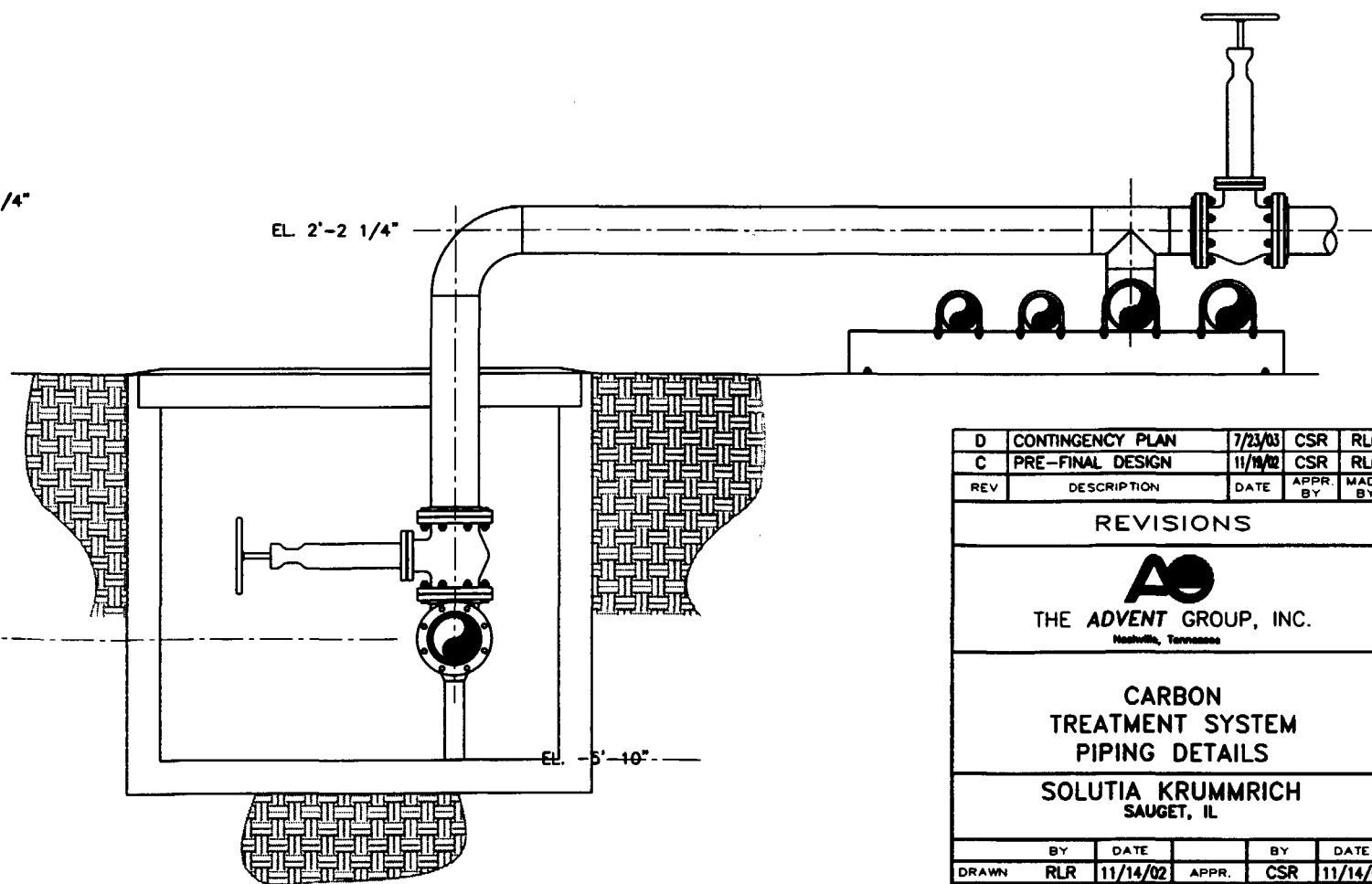
BY	DATE	BY	DATE
DRAWN RLR	11/18/02	APPR. CSR	11/18/02
CHKD. TL	11/18/02	SHEET 1 OF 1	SIZ. D
SCALE: 1:20	FILE LOCATION: L:\DATA\02691\CAD\C-01.DWG	CONTRACT NO.	DRAWING NO.
02691	C-01	REV.	D




CARBON VALVE PIT

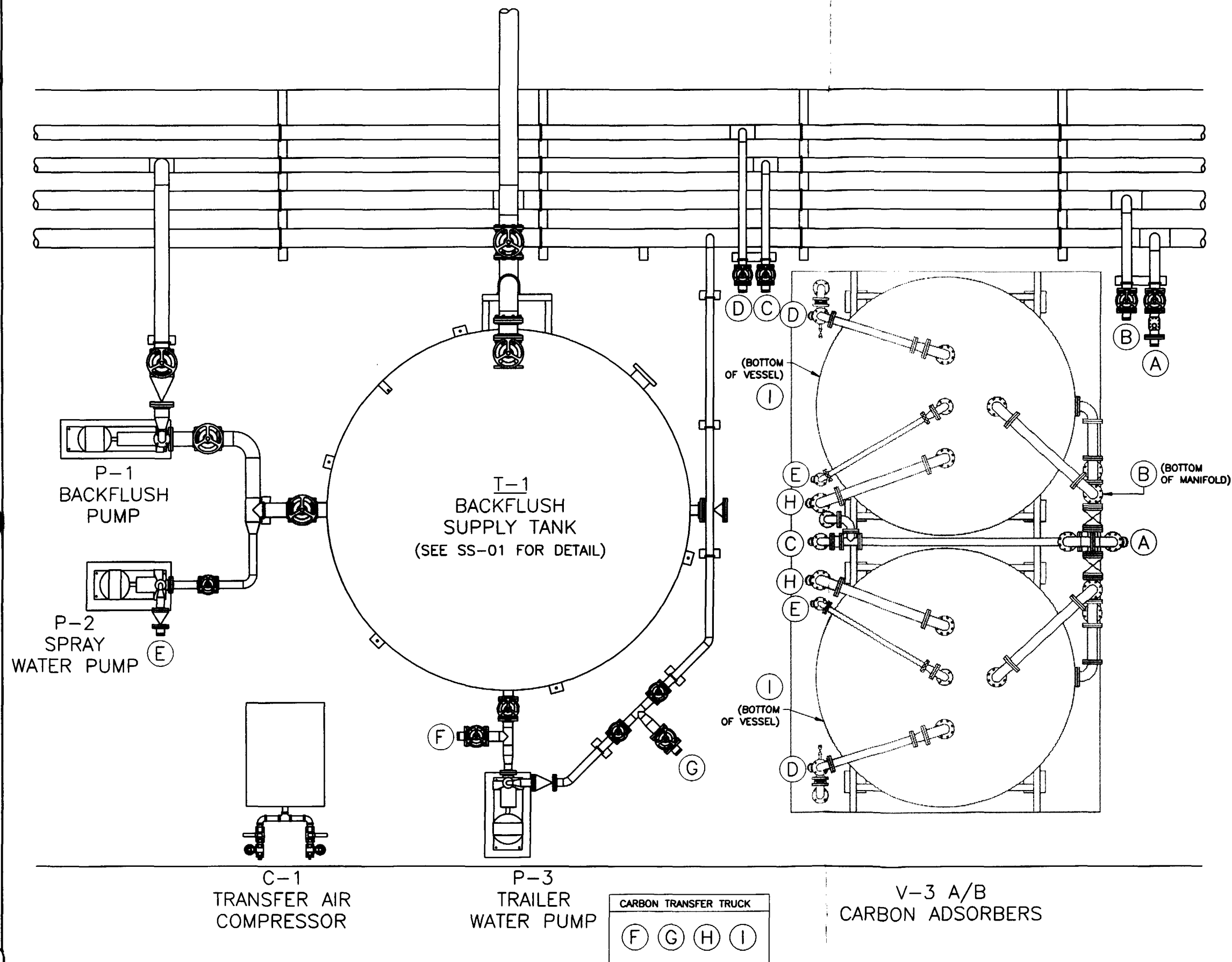


INFLUENT DETAIL



EFFLUENT DETAIL


D	CONTINGENCY PLAN	7/23/03	CSR	RLR
C	PRE-FINAL DESIGN	11/19/02	CSR	RLR
REV	DESCRIPTION	DATE	APPR BY	MADE BY
REVISIONS				
<div> THE ADVENT GROUP, INC. Nashville, Tennessee</div>				
CARBON TREATMENT SYSTEM PIPING DETAILS				
SOLUTIA KRUMMRICH SAUGET, IL				
BY	DATE		BY	DATE
DRAWN RLR	11/14/02	APPR.	CSR	11/14/02
CHKD. TL	11/14/02			
SCALE: 3/4"=1'-0"		SHEET 1 of 1		SIZE: D
FILE LOCATION: L:\DATA\02691\CAD\PIPING\DESIGN.DWG				
CONTRACT NO.		DRAWING NO.		REV.
02691		PP-02		D



NOTES:

1. CONNECTIONS A,B,C,D, ON EACH SKID HAVE DEDICATED MATCHING CONNECTIONS ON THE HEADER PIPING.
2. CONNECTION E ON THE DISCHARGE OF P-2 IS USED FOR ALL FOUR ADSORBER SKIDS.
3. A DUST CAP SHALL BE PROVIDED FOR ALL EXPOSED MALE ADAPTERS.

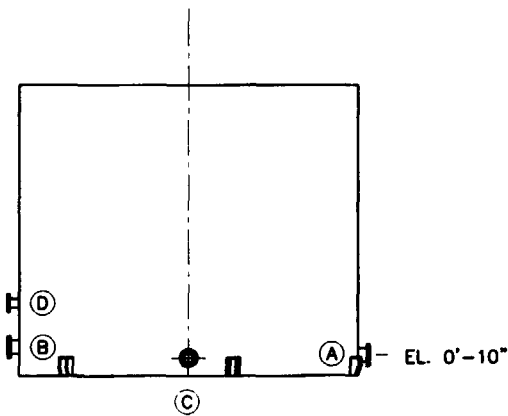
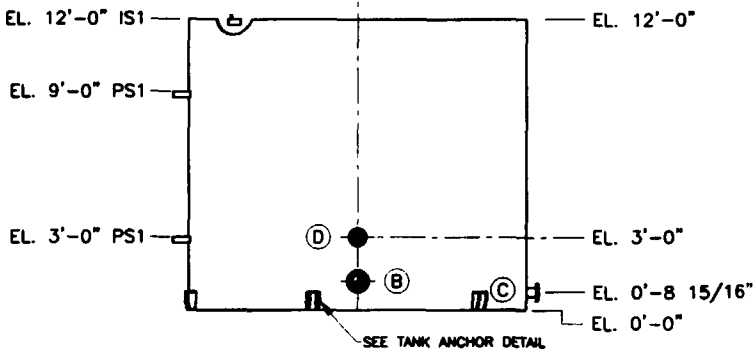
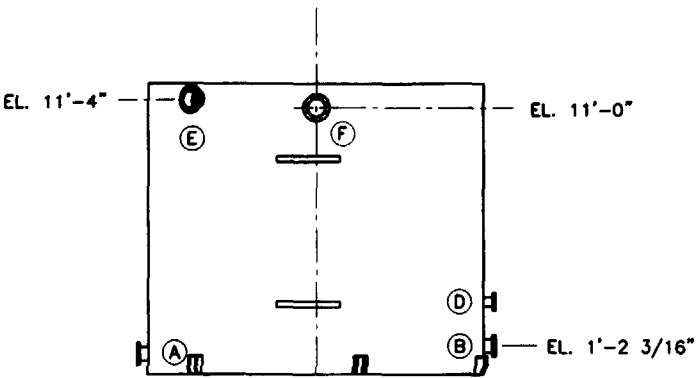
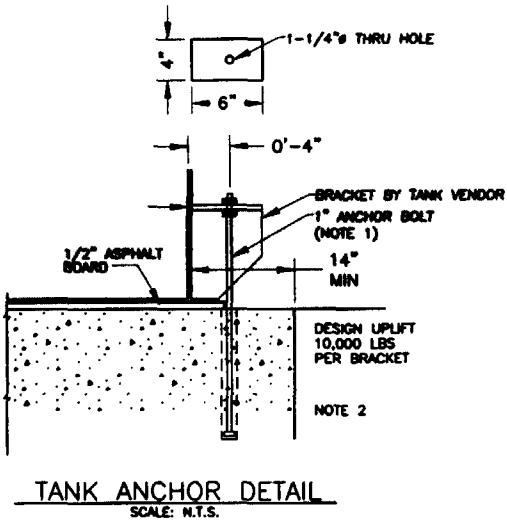
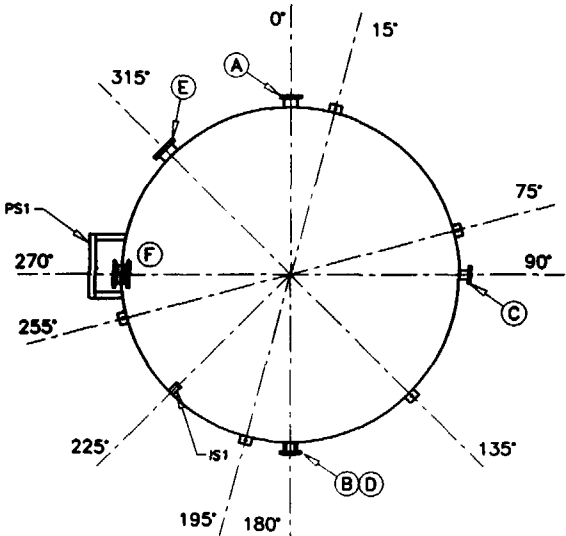
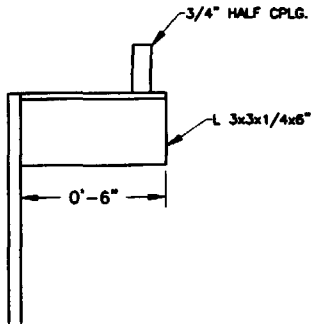
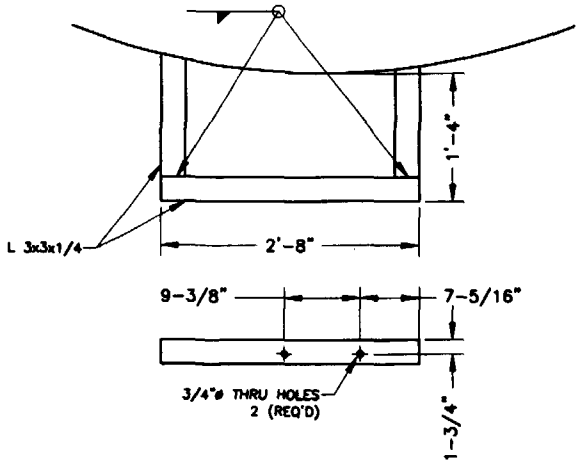
HOSE CONNECTION DETAIL LIST					
MARK	QTY.	SIZE	SERVICE	SOURCE	DISCHARGE
A	4	4"	CARBON INFLUENT	INFLUENT HEADER	VALVE MANIFOLD
B	4	4"	CARBON EFFLUENT	VALVE MANIFOLD	EFFLUENT HEADER
C	4	4"	BACKFLUSH SUPPLY	BACKFLUSH SUPPLY HEADER	VALVE MANIFOLD
D	4	4"	BACKFLUSH RETURN	CARBON VESSEL (3" PIPE)	BACKFLUSH RETURN HEADER
E	1	3"	SPRAY WATER	P-2 DISCHARGE	CARBON VESSEL (2" PIPE)
F	1	4"	CARBON SPENT SLURRY WATER	CARBON TRANSFER TRUCK	P-3 SUCTION
G	1	4"	FRESH CARBON SLURRY WATER	P-3 DISCHARGE	CARBON TRANSFER TRUCK
H	1	4"	FRESH CARBON SLURRY	CARBON TRANSFER TRUCK	CARBON VESSEL (4" PIPE, TOP)
I	1	4"	SPENT CARBON SLURRY	CARBON VESSEL (4" PIPE, BOTTOM)	CARBON TRANSFER TRUCK
J	1	1-1/2"	CARBON TRANSFER	AIR COMPRESSOR	CARBON ADSORBER
K	1	3/4"	CARBON TRANSFER	AIR COMPRESSOR	CARBON TRAILER

D	CONTINGENCY PLAN	7/23/03	CSR	RLR
C	PRE-FINAL DESIGN	11/18/02	CSR	RLR
REV	DESCRIPTION	DATE	APPR. BY	MADE BY
REVISIONS				
 THE ADVENT GROUP, INC. Nashville, Tennessee				
CARBON TREATMENT SYSTEM HOSE CONNECTION DETAILS				
SOLUTIA KRUMMRICH SAUGET, IL				
BY	DATE	APPR.	BY	DATE
DRAWN RLR	11/18/02		CSR	11/18/02
CHKD. TL	11/18/02			
SCALE: 1/2"=1'-0"		SHEET 1 OF 1	SIZE: D	
FILE LOCATION: DATA\02691\CAD\PIPING\DESIGN.DWG				
CONTRACT NO.	DRAWING NO.	REV.		
02691	PP-03	D		


NOTES:

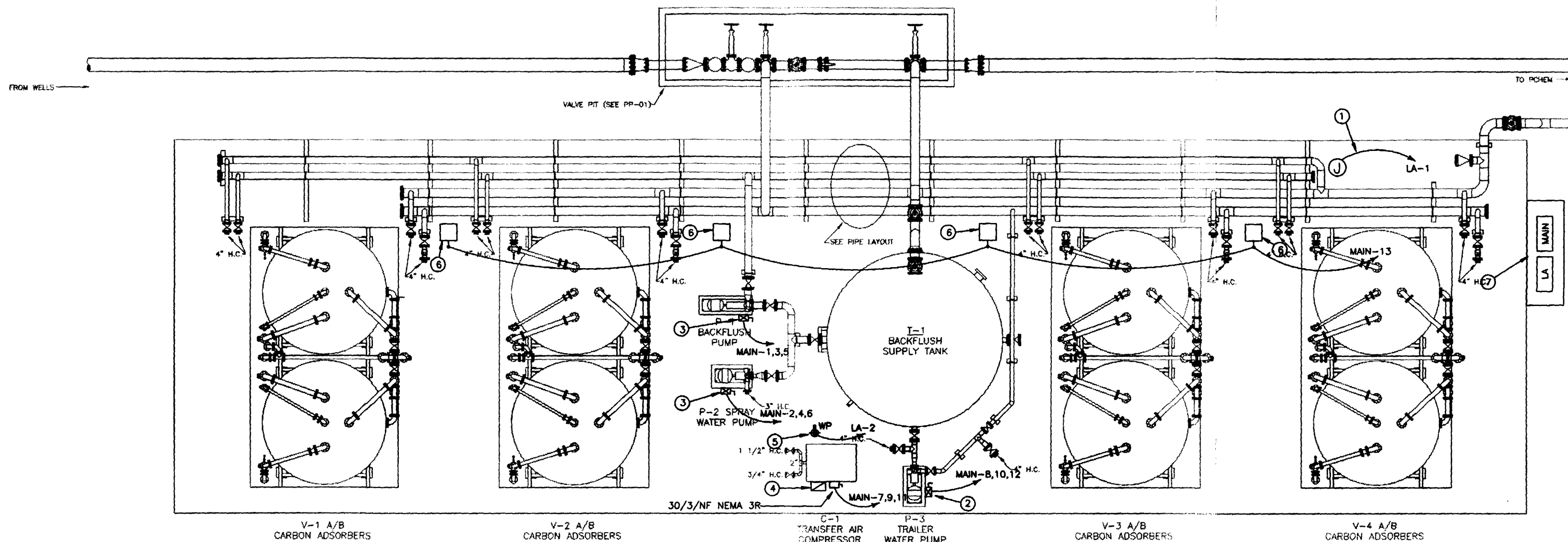
1. 1" ANCHOR BOLT TO BE HAS STANDARD ASTM A36 STEEL ROD SECURED WITH HY150 ADHESIVE PER HILTI. MINIMUM EMBEDMENT OF BOLT IS 8 1/4" BELOW TOP OF CONCRETE.
2. SITE WORK, SLAB, AND FOUNDATIONS TO BE DESIGNED BY OTHERS.

NOZZ.	QTY.	TYPE/ DESCRIPTION	ORIENT.	SERVICE		
A	1	6" 150# FLG	-	DRAIN		
B	1	8" 150# FLG	-	BACKFLUSH		
C	1	4" 150# FLG	-	TRAILER		
D	1	4" 150# FLG	-	SPARE		
E	1	8" 150# FLG	-	OVERFLOW		
F	2	8" 150# FLG/FLG	-	FILL		
G		
OVERALL DIMENSIONS (FT-INCH)						
HEIGHT	DIA	C	D	E	F	G
12'-0"	14'-0"					
DESIGN PRESS. PSIG	AMB	OP. PRESS. PSIG	ATM.			
DESIGN TEMP. DEG F	AMB	OP. TEMP. DEG F	70			
LIQUID WATER PH.	7.0	SP. GRAVITY	1.0			
DRY WT. LBS.	-	OP. WT. LBS.	-			
TANK VOL. GAL.	12,000					
DESIGN CODE:	API650, APPENDIX J					



I-1
BACKFLUSH SUPPLY TANK

D	CONTINGENCY PLAN	7/23/03	CSR	RLR
C	PRE-FINAL DESIGN	11/19/02	CSR	RLR
REV	DESCRIPTION	DATE	APPR. BY	MADE BY
REVISIONS				
 THE ADVENT GROUP, INC. Nashville, Tennessee				
BACKFLUSH SUPPLY TANK PLAN AND ELEVATION				
SOLUTIA KRUMMRICH SAUGET, IL				
BY	DATE	BY	DATE	
DRAWN RLR	11/14/02	APPR. CSR	11/14/02	
CHKD. TL	11/14/02			
SCALE: 1/4"=1'-0"	SHEET 1 OF 1	SIZE: D		
FILE LOCATION: L:\DATA\02691\CAD\PIPING\PP-01-03-SS-01.DWG				
CONTRACT NO.	DRAWING NO.	REV.		
02691	SS-01	D		



SCALE: 1/4" = 1'-0"
POWER LAYOUT

ELECTRICAL NOTES:

- (2) #12 AWG CONDUCTORS, (1) #12 AWG GROUND IN 3/4" CONDUIT CONCEALED IN CONCRETE FOR HEAT TRACING. STUB UP CONDUIT TO A JUNCTION BOX ON A UNISTRUT. COORDINATE EXACT LOCATION WITH ENGINEER IN FIELD.
- NON-FUSIBLE FULL VOLTAGE TYPE, NON-REVERSING STARTER WITH MELTING ALLOY OVERLOAD RELAY. 480V, NEMA SIZE 0, NEMA 3R ENCLOSURE.
- NON-FUSIBLE FULL VOLTAGE TYPE, NON-REVERSING STARTER WITH MELTING ALLOY OVERLOAD RELAY. 480V, NEMA SIZE 1, NEMA 3R ENCLOSURE.
- AIR COMPRESSOR CONTROL PANEL PROVIDED BY AIR COMPRESSOR MANUFACTURER.
- WEATHER PROOF QUAD RECEPTICAL, MOUNT ON UNISTRUT 36" AFG.
- LITHONIA MODEL KAD 250S R4 277 SPD04 PE7 DBL LIGHT FIXTURE MOUNTED ON A LITHONIA MODEL RSSS 25 4-C DM19 DBL POLE OR EQUAL. REFER TO DRAWING E-2 FOR FOUNDATION DETAIL. COORDINATE EXACT LOCATION WITH ENGINEER IN FIELD.
- 2'-6" BY 5' CONCRETE SLAB 4" MINIMUM THICK, TURNDOWN EDGES MINIMUM 12" BELOW GRADE BY MINIMUM 6" WIDE. WITH (5) #4 CONTINUOUS BARS AND (4) #3 "U"-BARS AT 18" ON CENTER. TOP OF SLAB SHALL HAVE LIGHT BROOM FINISH. CONCRETE TO BE MINIMUM 3000 PSI COMPRESSIVE STRENGTH, AIR-ENTRAINED.

B	CONTINGENCY PLAN	7/23/03	CSR	RLR
A	PRE-FINAL DESIGN	11-28-02	MN	
REV	DESCRIPTION	DATE	APPR. BY	MADE BY

REVISIONS



THE ADVENT GROUP, INC.
Nashville, Tennessee

**ELECTRICAL
POWER LAYOUT**

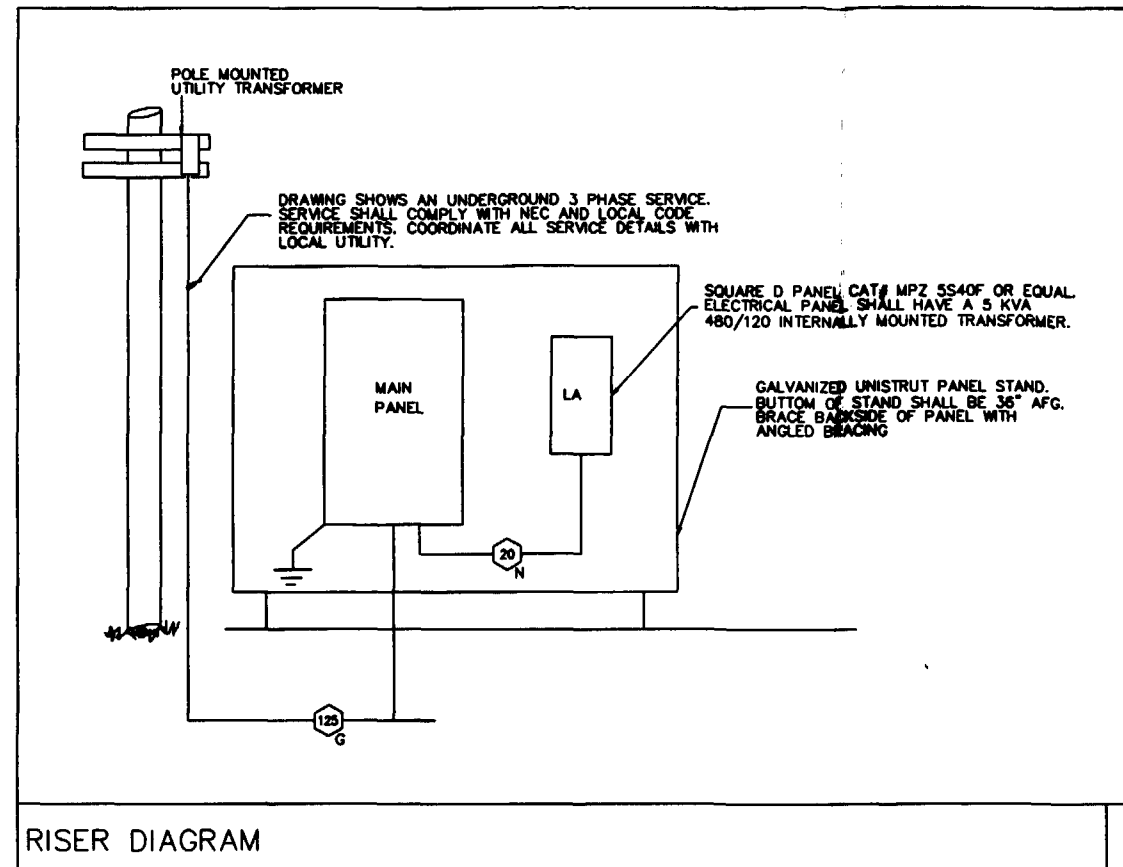
SOLUTIA KRUMMRICH
SAUGET, IL

BY	DATE	BY	DATE
DRAWN MAN	11/19/02	APPR. SDD	11/19/02
CHKD. SDD	11/19/02		
SCALE: AS SHOWN	SHEET 1 OF 2	SIZE: D	
FILE LOCATION: L:\DATA\02691\ELECTRICAL\E-01_02.DWG			
CONTRACT NO. 02691	DRAWING NO. E-01	REV. B	

FEEDER SCHEDULE			
NO.	CONDUCTORS THWN/THWN COPPER	CONDUIT	CONDUIT W.O. NEUTRAL
20	4#12, 1#12G	3/4"	3/4"
30	4#10, 1#10G	3/4"	3/4"
40	4#8, 1#10G	3/4"	3/4"
50	4#8, 1#10G	3/4"	3/4"
60	4#8, 1#10G	1"	3/4"
70	4#8, 1#8G	1"	3/4"
80	4#4, 1#8G	1 1/4"	1"
90	4#4, 1#8G	1 1/4"	1"
100	4#3, 1#8G	1 1/2"	1"
120	4#1, 1#8G	1 1/2"	1 1/4"
130	4#1/0, 1#8G	1 1/2"	1 1/2"
175	4#2/0, 1#8G	2"	1 1/2"
200	4#3/0, 1#8G	2"	2"

WHERE THE FEEDER SYMBOL IS SHOWN WITH THE SUBSCRIPT "N" SUCH AS \bigcirc_{20}^N THE NEUTRAL CONDUCTOR SHALL BE DELETED FROM THE CONDUCTORS SHOWN IN THE FEEDER SCHEDULE.

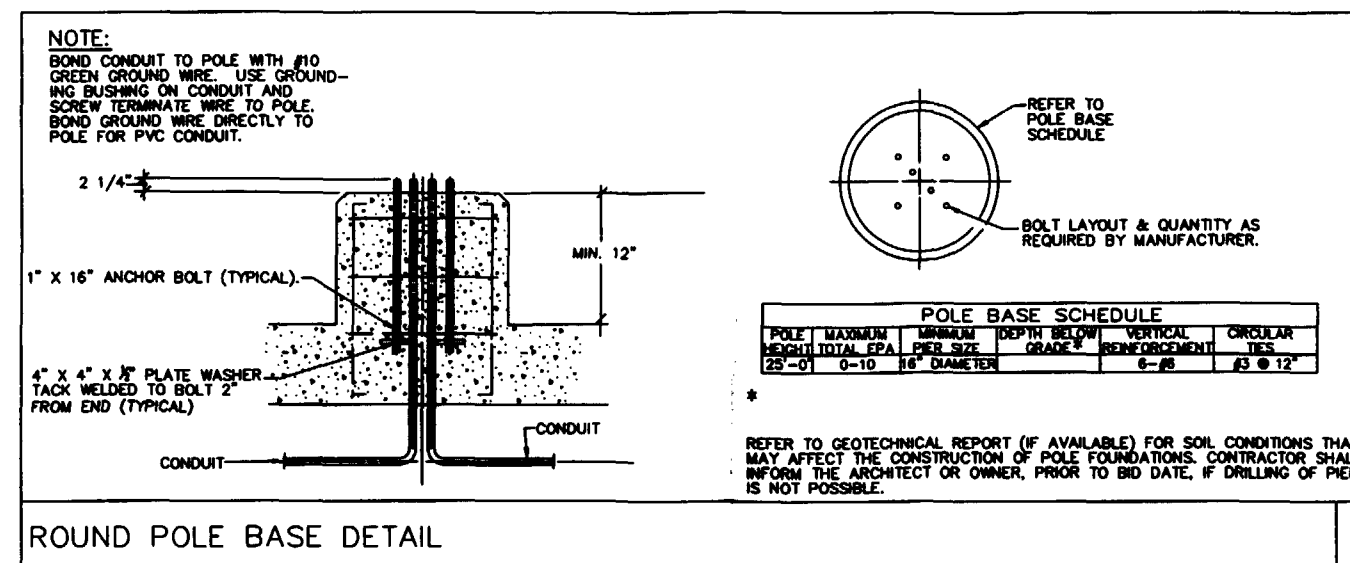
WHERE THE FEEDER SYMBOL IS SHOWN WITH THE SUBSCRIPT "G" SUCH AS \bigcirc_{20}^G THE GROUNDING CONDUCTOR SHALL BE DELETED FROM THE CONDUCTORS SHOWN IN THE FEEDER SCHEDULE.




PANEL LOCATION: LA OUTSIDE FED FROM: BUS-NA		DC DEVICE TYPE: Breaker DEVICE FAMILY: Bolt On		ENCLOSURE: NEMA 3R MOUNTING: Surface VOLTAGE: 120		MAIN(S): NLD WIRING: 1 PHASE 2 WIRE		BUS RATING(A): 40 BUS WITHSTAND(A): 40 FAULT CURRENT(A): 1469				
DC AMPS P	NOTES	DESCRIPTION	DEMAND CODE	VA	CKT	PHASE LOADS A B C	CKT	VA	DEMAND CODE	DESCRIPTION	NOTES	DC AMPS P
20 1 20 1		HEAT TRACE SPARE	GEN GEN	1801 0	1 3 5	2401	2 4 6	1801 0	REC GEN	RECEPTICALS SPARE		20 1 20 1
SCHEDULE TOTALS		KVA	AMPS	H PHASE A TOTALS		VA	AMPS	BUS TOTALS		KVA	DATE: Nov 19, 2002	
TOTAL CONNECTED		2.4	6.7	H PHASE B		2401.8	20.0	CONNECTED		2.4	TIME: 16:40:16	
TOTAL DEMAND		2.4	6.7	H PHASE C		0.0	0.0	DEMAND		2.4		
TOTAL DESIGN		2.4	6.7			0.0	0.0	DESIGN		2.4		

PANEL LOCATION: FEB FROM	MAIN OUTSIDE UTILITY	DC DEVICE TYPE: Breaker DEVICE FAMILY: Bolt On	ENCLOSURE MOUNTING: NEMA 3R VOLTAGE: Surface 480	MAIN(CA): 125A 3 POLE MAIN WIRING: 3 PHASE 4 WIRE	BUS RATING(CA): 125 BUS WITHSTAND(CA): 125 FAULT CURRENT(CA): 38400							
DC AMP P	NOTES	DESCRIPTION	DEMOM CODE	VA	CKT	PHASE A LOADS VA B C	CKT	VA	DEMOM CODE	DESCRIPTION	NOTES	DC AMP P
15 3		P-1 STARTER	GEN	2800	1	5433	2	3333	GEN	P-2 STARTER		25 3
		"		2800	3		4	3333		"		
		"		2800	5		6	3333		"		
25 3		AIR COMPRESSOR C-1	GEN	3823	7	5000	8	1667	GEN	P-3 STARTER		15 3
		"		3823	12		10	1667		"		
		"		3823	11		12	1667		"		
20 1		LIGHTING	LTS	3048	13	7205	14	4157	REC	SPARE		20 3
20 2		LA	GEN	2400	15		16	4157		"		
		"	GEN	2400	17		18	4157		"		
					19		20					
					21		22					
					23		24					
SCHEDULE TOTALS		KVA	AMPS	# PHASE	TOTALS	VA	AMPS	BUS TOTALS		KVA		
TOTAL CONNECTED		48.0	57.8	# PHASE	7	18038.7	65.1	CONNECTED		50.4	DATE: Nov 19, 2002	
TOTAL DEMAND		46.8	56.3	# PHASE	3	14990.3	54.1	DEMAND		48.6	TIME: 16:49:16	
TOTAL DESIGN		47.3	57.2	# PHASE	3	14990.3	54.1	DESIGN		49.3		

LEGEND		
SYMBOL	DESCRIPTION	WTC HEIGHT APP TO CL LUM
	NOTE REFERENCE—REFER TO NOTE INDICATED.	_____
	CONCEALED CONDUIT	_____
	EXPOSED CONDUIT ON WALL, CEILING, OR PIPE RACK	_____
	HOMERUN CONDUIT (MIN. 3/12-1/2" C.)	_____
	CONDUIT CONCEALED IN FLOOR OR BELOW GRADE	_____
	FLEX CONDUIT CONNECTION	_____
	MANUAL MOTOR STARTER, "T" INDICATES THERMAL OVERLOAD, SEE SPECS.	46"
	120V. QUADPLEX RECEPTACLE - IVORY - SPECIAL MOUNTING HEIGHT (REFER TO ABBREVIATIONS FOR EXCEPTIONS)	AS NOTED OR SEE SPECS.
	START/STOP PUSH BUTTON MOUNTED ON UNISTRUT NEXT TO MOTOR (REFER TO ABBREVIATIONS FOR EXCEPTIONS)	_____
	HAND/OFF/AUTOMATIC SWITCH MOUNTED ON UNISTRUT NEXT TO MOTOR	_____
	JUNCTION BOX	_____
	SAFETY SWITCH, SIZE AS NOTED (AMP RATING/POLES/ENCLOSURE)	_____
	SAFETY SWITCH, SIZE AS NOTED (AMP RATING/POLES/FUSE SIZE)	_____
	COMBINATION MAGNETIC ACROSS-THE-LINE STARTER W/MOTOR CIRCUIT PROTECTOR	_____
	TRANSFORMER	_____
	MOTOR	_____
	CONTROL PANEL (NEMA 12, UNLESS OTHERWISE NOTED)	_____
	ABOVE FINISHED GROUND	_____
	UNLESS OTHERWISE NOTED	_____
	WEATHERPROOF DEVICE	_____
	FURNISHED BY OTHERS	_____
	STUB UP CONDUIT AT SHOWN LOCATION	_____
	POLE MOUNTED LIGHT FIXTURE	_____
NOT ALL SYMBOLS ON THIS LEGEND APPEAR ON THIS PROJECT		_____



B	CONTINGENCY PLAN	7/23/03	CSR	RLR
A	PRE-FINAL DESIGN	11/20/02	MN	
REV	DESCRIPTION	DATE	APPR. BY	MADE BY
REVISIONS				
 <p>THE ADVENT GROUP, INC. Nashville, Tennessee</p>				
<p>ELECTRICAL PANEL SCHEDULES, ONE-LINE RISER DIAGRAM AND DETAILS</p>				
<p>SOLUTIA KRUMMRICH SAUGET, IL</p>				
	BY	DATE		DATE
DRAWN	MAN	11/19/02	APPR.	SDD 11/19/02
CHKD.	SDD	11/19/02		
SCALE: AS SHOWN		SHEET 2 OF 2		SIZE: D
FILE LOCATION: GA_E-1_E-2.DWG				
CONTRACT NO.		DRAWING NO.		REV.
		E-02		B

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THE ADVENT GROUP, INC.

201 SUMMIT VIEW DRIVE
THIRD FLOOR
BRENTWOOD, TENNESSEE 37027
615-377-4775
615-377-4976 (Facsimile)

PROPOSAL PROJECT NO. 2269 SHEET 1 OF 1

PROPOSAL PROJECT NAME Krummhorn Detention Design

BY MAJBY DATE 11/13/02

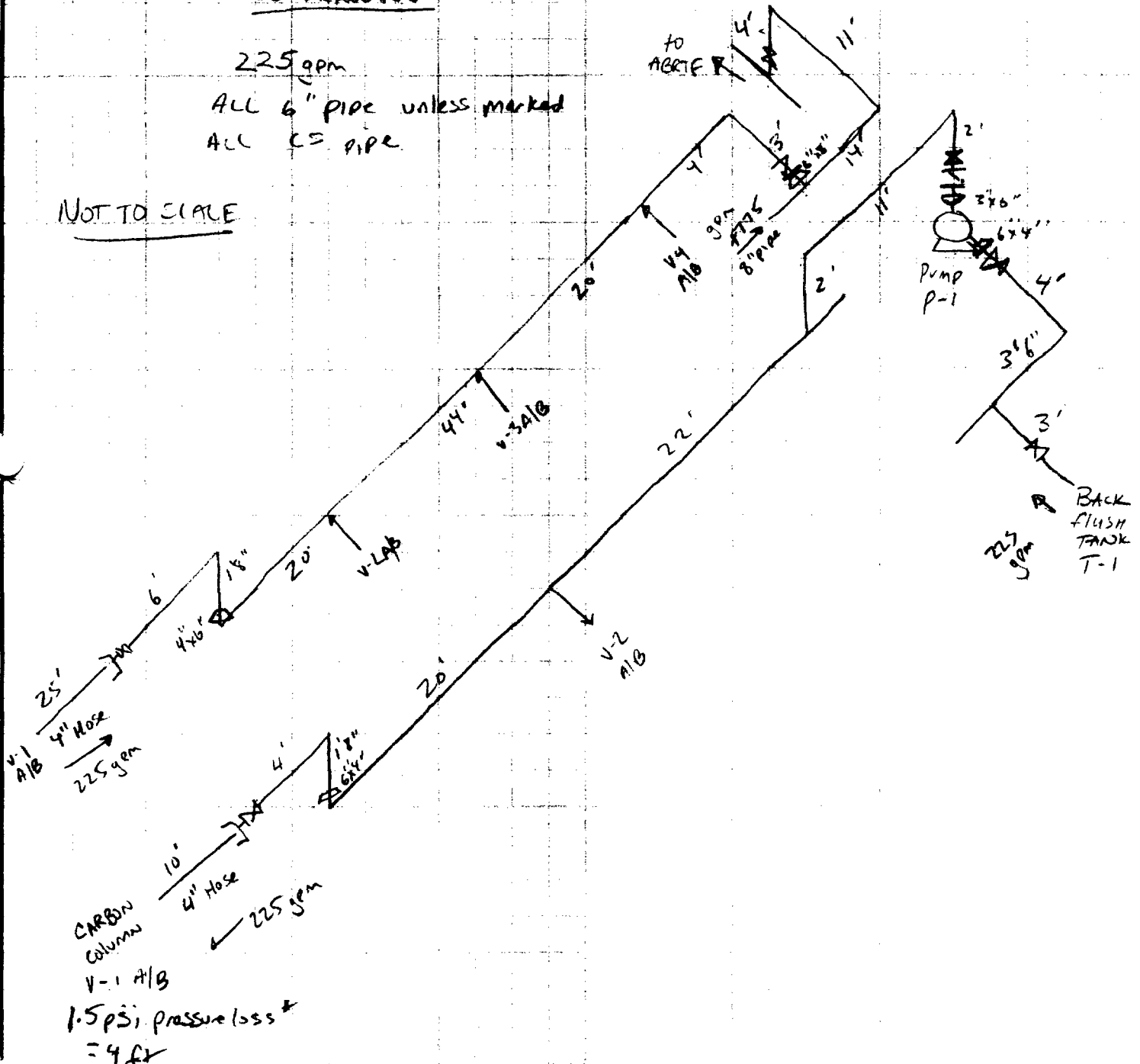
CHECKED BY CLC DATE 11/19/02

P-1 BACKFLUSH PUMP ISO DRAWING

225 gpm

ALL 6" PIPE UNLESS MARKED
ALL CS PIPE

NOT TO SCALE

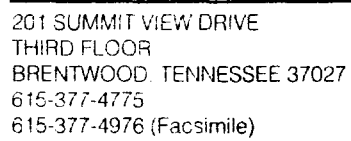


* - BASED ON CHART FOR DUAL MODULE - FLOW AT 225 gpm

225	=Starting Flow - gpm	Title: BackFlush Head Loss Calculation							
100	=Elev @ Start - feet	Item Loss and Hydraulic Gradient							
120	=Default C-Value >25	New C:	140	HiGrf	LoGrf	PmpCorr			
6	=Default Diam - Inch	New D:	24	175	=Target Head Loss				
20	=Dflt Pipe Lnth- Feet	15.419				=Total Head Loss - feet			
Date:	18-Nov-2002	ParaEq=	=EquivLnth(Std=def) - Feet						
Flow gpm	Item Description Of Friction Loss	Diam Inch	K or Fixd Cval Loss	Lngh Feet	Itm Nmb	Loss feet	HydGrad feet	Vel fps	V-Hd feet
225	Inwd Projtg Entr.	6	1.5		1	0.15	100.15	2.6	0.1
225	Gate Valve	6	0.2		2	0.02	100.17	2.6	0.1
225	Straight Pipe	6	120	3	3	0.02	100.19	2.6	0.1
225	Branch Flow Tee	6	1		4	0.10	100.29	2.6	0.1
225	Straight Pipe	6	120	3.5	5	0.02	100.31	2.6	0.1
225	90 Dgr Elbow	6	0.6		6	0.06	100.37	2.6	0.1
225	Straight Pipe	6	120	4	7	0.02	100.39	2.6	0.1
225	Gate Valve	6	0.2		8	0.02	100.41	2.6	0.1
225	Reducer	6	2		9	0.20	100.61	2.6	0.1
225	Increaser	3	1		10	1.62	102.23	10.	1.62
225	Swing Check Valve	6	2		11	0.20	102.44	2.6	0.1
225	Gate Valve	6	0.2		12	0.02	102.46	2.6	0.1
225	Straight Pipe	6	120	2	13	0.01	102.47	2.6	0.1
225	90 Dgr Elbow	6	0.6		14	0.06	102.53	2.6	0.1
225	Straight Pipe	6	120	11	15	0.06	102.59	2.6	0.1
225	90 Dgr Elbow	6	0.6		16	0.06	102.65	2.6	0.1
225	Straight Pipe	6	120	2	17	0.01	102.66	2.6	0.1
225	Branch Flow Tee	6	1		18	0.10	102.76	2.6	0.1
225	Straight Pipe	6	120	22	19	0.12	102.88	2.6	0.1
225	Passing Tee	6	0.8		20	0.08	102.96	2.6	0.1
225	Straight Pipe	6	120	20	21	0.11	103.07	2.6	0.1
225	90 Dgr Elbow	6	0.6		22	0.06	103.13	2.6	0.1
225	Reducer	6	2		23	0.20	103.33	2.6	0.1
225	Straight Pipe	4	120	1.67	24	0.07	103.40	5.7	0.5
225	90 Dgr Elbow	4	0.6		25	0.31	103.71	5.7	0.5
225	Straight Pipe	4	120	4	26	0.16	103.86	5.7	0.5
225	Gate Valve	4	0.2		27	0.10	103.97	5.7	0.5
225	Straight Pipe	4	80	10	28	0.83	104.80	5.7	0.5
225	Column Back Flush			4	29	4.00	108.80		
225	Straight Pipe	4	80	25	30	2.07	110.87	5.7	0.5
225	Gate Valve	4	0.2		31	0.10	110.97	5.7	0.5
225	Straight Pipe	4	120	6	32	0.23	111.21	5.7	0.5
225	90 Dgr Elbow	4	0.6		33	0.31	111.51	5.7	0.5
225	Straight Pipe	4	120	1.67	34	0.07	111.58	5.7	0.5
225	Increaser	4	1		35	0.51	112.09	5.7	0.5
225	90 Dgr Elbow	6	0.6		36	0.06	112.15	2.6	0.1
225	Straight Pipe	6	120	20	37	0.11	112.26	2.6	0.1
225	Passing Tee	6	0.8		38	0.08	112.34	2.6	0.1
225	Straight Pipe	6	120	44	39	0.24	112.58	2.6	0.1
225	Passing Tee	6	0.8		40	0.08	112.66	2.6	0.1
225	Straight Pipe	6	120	20	41	0.11	112.77	2.6	0.1
225	Passing Tee	6	0.8		42	0.08	112.85	2.6	0.1
225	Straight Pipe	6	120	4	43	0.02	112.87	2.6	0.1
225	90 Dgr Elbow	6	0.6		44	0.06	112.93	2.6	0.1
225	Straight Pipe	6	120	3	45	0.02	112.95	2.6	0.1
225	Swing Check Valve	6	2		46	0.20	113.15	2.6	0.1
225	Increaser	6	1		47	0.10	113.25	2.6	0.1
225	Branch Flow Tee	8	1		48	0.03	113.29	1.4	0.03

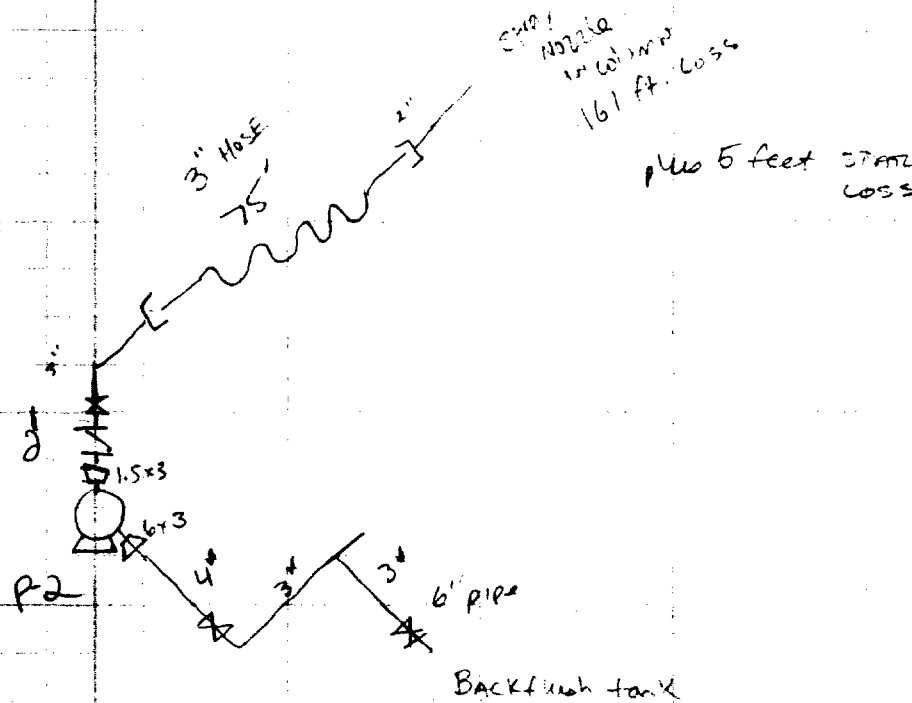
1000 Straight Pipe	8	120	14	49	0.30	113.58	6.4	0.64
1000 90 Dgr Elbow	8	0.6		50	0.38	113.96	6.4	0.64
1000 Straight Pipe	8	120	11	51	0.23	114.20	6.4	0.64

1000 90 Dgr Elbow	8	0.6		52	0.38	114.58	6.4	0.64
1000 Straight Pipe	8	120	4	53	0.08	114.66	6.4	0.64
1000 Gate Valve	8	0.2		54	0.13	114.79	6.4	0.64
1000 Branch Flow Tee	8	1		55	0.63	115.42	6.4	0.64
1000				56				
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CHECKED BY CE DATE 11

SUBJECT: [REDACTED] (K) [REDACTED]
[REDACTED] [REDACTED] [REDACTED]



100	=Starting Flow - gpm	Title: Spray Water Head Loss Calc							
100	=Elev @ Start - feet	Item Loss and Hydraulic Gradient							
120	=Default C-Value >25	New C: 140	HiGrf	LoGrf	PmpCorr				
6	=Default Diam - Inch	New D: 24	175	=Target Head Loss					
20	=Dflt Pipe Lnth- Feet	177.83					=Total Head Loss - feet		
Date: 13-Nov-2002	ParaEq=	9782.1					=EquivLnth(Std=def) - Feet		
Flow gpm	Item Description	Diam	K or Fixd Cval	Lnth Feet	Itm Nmb	Loss feet	HydGrad feet	Vel fps	
=====	=====	=====	=====	=====	=====	=====	=====	=====	
100	Inwd Projtg Entr.	6	1.5		1	0.03	100.03	1.1	
100	Gate Valve	6	0.2		2	0.00	100.03	1.1	
100	Straight Pipe	6	120	3	3	0.00	100.04	1.1	
100	Branch Flow Tee	6	1		4	0.02	100.06	1.1	
100	Straight Pipe	6	120	3	5	0.00	100.06	1.1	
100	90 Dgr Elbow	6	0.6		6	0.01	100.07	1.1	
100	Straight Pipe	6	120	4	7	0.00	100.08	1.1	
100	Gate Valve	6	0.2		8	0.00	100.08	1.1	
100	Reducer	6	2		9	0.04	100.12	1.1	
100	Increaser	1.5	1		10	5.12	105.24	18.	
100	Swing Check Valve	3	2		11	0.64	105.88	4.5	
100	Gate Valve	3	0.2		12	0.06	105.95	4.5	
100	Straight Pipe	3	120	2	13	0.07	106.02	4.5	
100	90 Dgr Elbow	3	0.6		14	0.19	106.21	4.5	
100	Straight Pipe	3	80	75	15	5.62	111.83	4.5	
100	Spray nozzle			161	16	161.00	272.83		
100	Fixed Static Head			5	17	5.00	277.83		
100					18				
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THE ADVENT GROUP, INC.

201 SUMMIT VIEW DRIVE
THIRD FLOOR
BRENTWOOD, TENNESSEE 37027
615-377-4775
615-377-4976 (Facsimile)

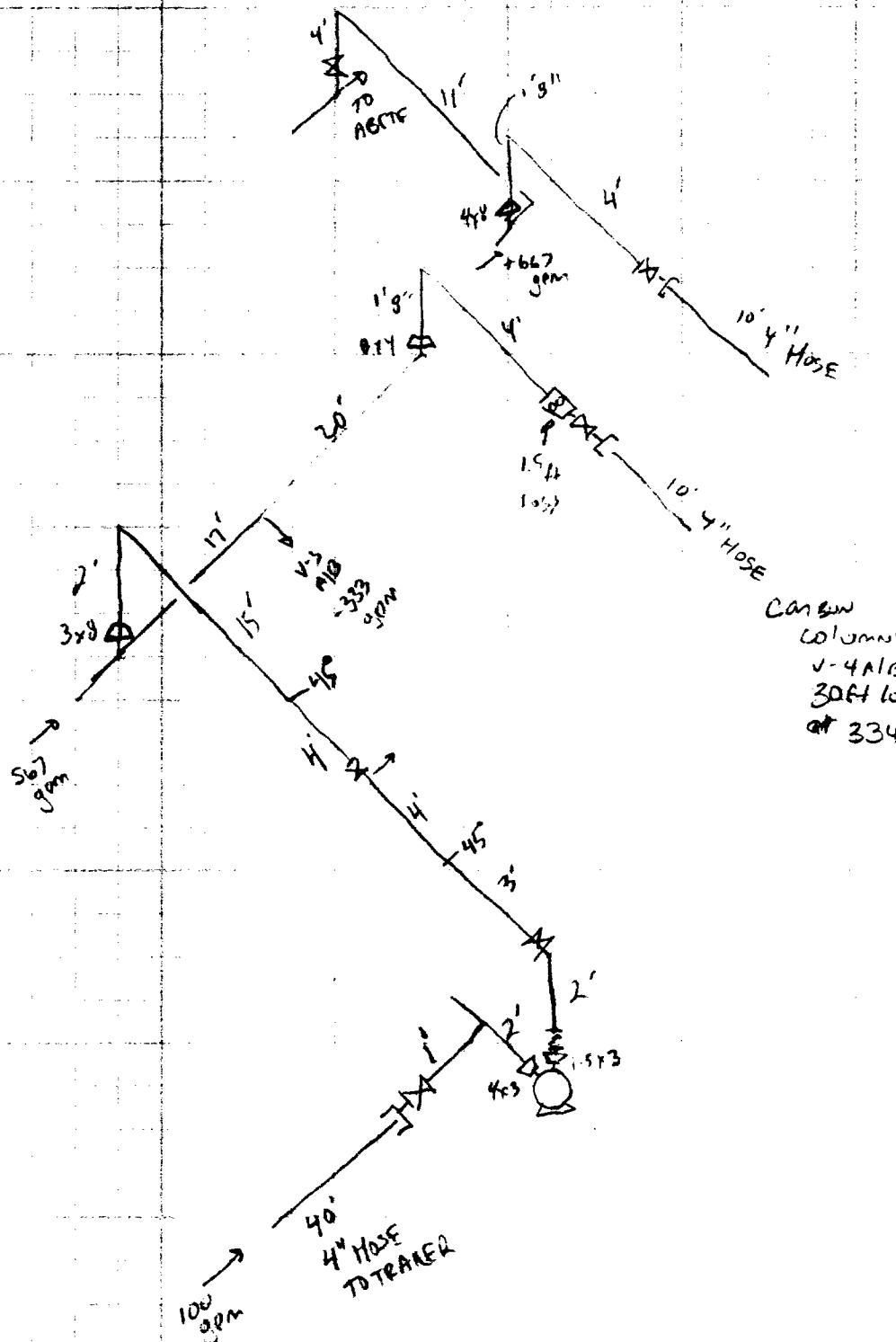
PROPOSAL PROJECT NO. 2252 SHEET 1

PROPOSAL PROJECT NAME KUMON Detail D

BY Mm DATE 11/12

CHECKED BY CC DATE 11/12

P-3 TRAILER DEWATERING
ISODRAWING
NOT TO SCALE

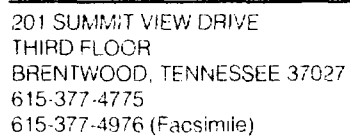


100	=Starting Flow -	gpm	Title: P3 Head Loss - Trailer Dewatering						
100	=Elev @ Start -	feet	Item Loss and Hydraulic Gradient						
120	=Default C-Value	>25	New C:	140	HiGrf	LoGrf	PmpCorr		
8	=Default Diam -	Inch	New D:	24	175	=Target Head Loss			
20	=Dflt Pipe Lnth-	Feet	50.547				=Total Head Loss - feet		
Date:	18-Nov-2002	ParaEq=					=EquivLnth(Std=def) - Feet		
Flow	Item Description	Diam	K or Fixd	Lngh	Itm	Loss	HydGrad	Vel	
gpm	Of Friction Loss	Inch	Cval Loss	Feet	Nmb	feet	feet	fps	
=====									
100	Straight Pipe	4	80	40	1	0.74	100.74	2.6	
100	Gate Valve	4	0.2		2	0.02	100.76	2.6	
100	Straight Pipe	4	120	1	3	0.01	100.77	2.6	
100	Branch Flow Tee	4	1		4	0.10	100.87	2.6	
100	Straight Pipe	4	120	2	5	0.02	100.89	2.6	
100	Reducer	4	2		6	0.20	101.09	2.6	
100	Increaser	1.5	1		7	5.12	106.21	18.	
100	Swing Check Valve	3	2		8	0.64	106.85	4.5	
100	Straight Pipe	3	120	2	9	0.07	106.92	4.5	
100	90 Dgr Elbow	3	0.6		10	0.19	107.11	4.5	
100	Gate Valve	3	0.2		11	0.06	107.18	4.5	
100	Straight Pipe	3	120	3	12	0.11	107.28	4.5	
100	45 Dgr Elbow	3	0.3		13	0.10	107.38	4.5	
100	Straight Pipe	3	120	4	14	0.14	107.52	4.5	
100	Passing Tee	3	0.8		15	0.26	107.78	4.5	
100	Gate Valve	3	0.2		16	0.06	107.84	4.5	
100	Straight Pipe	3	120	4	17	0.14	107.98	4.5	
100	45 Dgr Elbow	3	0.3		18	0.10	108.08	4.5	
100	Straight Pipe	3	120	15	19	0.53	108.61	4.5	
100	90 Dgr Elbow	3	0.6		20	0.19	108.80	4.5	
100	Straight Pipe	3	120	2	21	0.07	108.87	4.5	
100	Increaser	3	1		22	0.32	109.19	4.5	
100	Branch Flow Tee	8	1		23	0.01	109.20	0.6	
667	Straight Pipe	8	120	17	24	0.17	109.37	4.3	
667	Passing Tee	8	0.8		25	0.23	109.59	4.3	
334	Straight Pipe	8	120	20	26	0.06	109.65	2.1	
334	90 Dgr Elbow	8	0.6		27	0.04	109.69	2.1	
334	Reducer	8	2		28	0.14	109.83	2.1	
334	Straight Pipe	4	120	1.67	29	0.14	109.97	8.5	
334	90 Dgr Elbow	4	0.6		30	0.68	110.65	8.5	
334	Straight Pipe	4	120	4	31	0.33	110.97	8.5	
334	Flow Meter			1.5	32	1.50	112.47		
334	Gate Valve	4	0.2		33	0.23	112.70	8.5	
334	Straight Pipe	4	80	10	34	1.72	114.42	8.5	
334	Carbon Column			30	35	30.00	144.42		
334	Straight Pipe	4	80	10	36	1.72	146.14	8.5	
334	Gate Valve	4	0.2		37	0.23	146.37	8.5	
334	Straight Pipe	4	120	4	38	0.33	146.70	8.5	
334	90 Dgr Elbow	4	0.6		39	0.68	147.37	8.5	
334	Straight Pipe	4	120	1.67	40	0.14	147.51	8.5	
334	Increaser	4	1		41	1.13	148.64	8.5	
334	Branch Flow Tee	8	1		42	0.07	148.71	2.1	
1000	90 Dgr Elbow	8	0.6		43	0.38	149.09	6.4	
1000	Straight Pipe	8	120	11	44	0.23	149.32	6.4	
1000	90 Dgr Elbow	8	0.6		45	0.38	149.70	6.4	
1000	Straight Pipe	8	120	4	46	0.08	149.79	6.4	
1000	Gate Valve	8	0.2		47	0.13	149.91	6.4	
1000	Branch Flow Tee	8	1		48	0.63	150.55	6.4	

1000

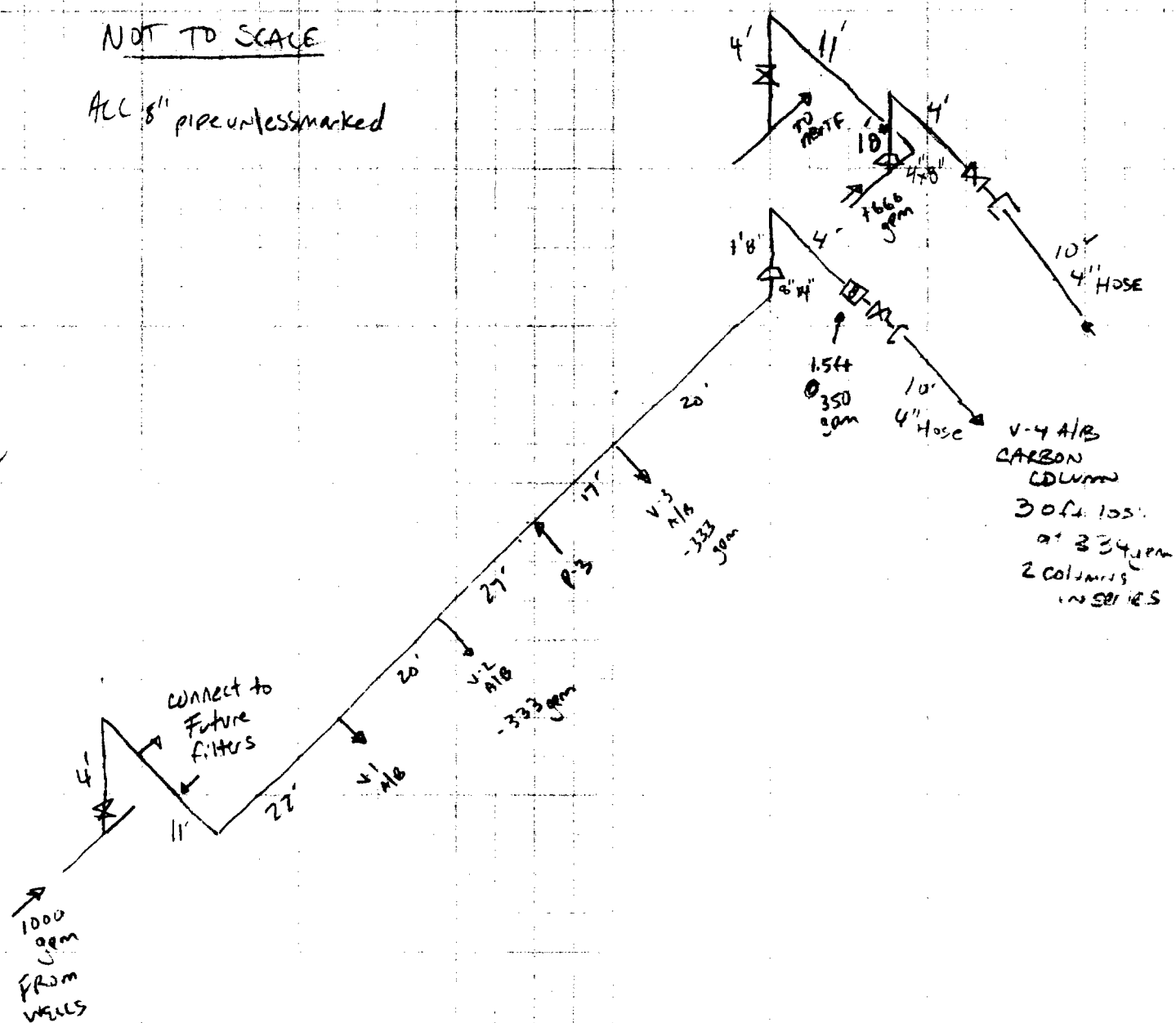
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CHECKED BY CC DATE 11/19/02

ALL 8" pipe unless marked



1000 =Starting Flow - gpm Title: System Head Loss Calculation
 100 =Elev @ Start - feet Item Loss and Hydraulic Gradient
 120 =Default C-Value >25 New C: 140 HiGrf LoGrf PmpCorr
 8 =Default Diam - Inch New D: 24 175 =Target Head Loss
 20 =Dflt Pipe Lnth- Feet 46.596 =Total Head Loss - feet

Date: 18-Nov-2002 ParaEq=

=EquivLnth(Std=def) - Feet

Flow gpm	Item Description Of Friction Loss Inch	Diam Inch	K or Fixd Cval Loss	Lnth Feet	Itm Nmb	Loss feet	HydGrad feet	Vel fps	V-Hd feet
1000	Branch Flow Tee	8	1		1	0.63	100.63	6.4	0.64
1000	Straight Pipe	8	120	4	2	0.08	100.72	6.4	0.64
1000	Gate Valve	8	0.2		3	0.13	100.84	6.4	0.64
1000	90 Dgr Elbow	8	0.6		4	0.38	101.22	6.4	0.64
1000	Passing Tee	8	0.8		5	0.51	101.73	6.4	0.64
1000	Passing Tee	8	0.8		6	0.51	102.24	6.4	0.64
1000	Straight Pipe	8	120	11	7	0.23	102.47	6.4	0.64
1000	90 Dgr Elbow	8	0.6		8	0.38	102.85	6.4	0.64
1000	Straight Pipe	8	120	22	9	0.47	103.32	6.4	0.64
1000	Passing Tee	8	0.8		10	0.51	103.82	6.4	0.64
1000	Straight Pipe	8	120	20	11	0.42	104.25	6.4	0.64
1000	Passing Tee	8	0.8		12	0.51	104.75	6.4	0.64
667	Straight Pipe	8	120	27	13	0.27	105.02	4.3	0.29
667	Passing Tee	8	0.8		14	0.23	105.25	4.3	0.29
667	Straight Pipe	8	120	17	15	0.17	105.42	4.3	0.29
667	Passing Tee	8	0.8		16	0.23	105.64	4.3	0.29
334	Straight Pipe	8	120	20	17	0.06	105.70	2.1	0.07
334	90 Dgr Elbow	8	0.6		18	0.04	105.74	2.1	0.07
334	Reducer	8	2		19	0.14	105.88	2.1	0.07
334	Straight Pipe	4	120	1.67	20	0.14	106.02	8.5	1.12
334	90 Dgr Elbow	4	0.6		21	0.68	106.70	8.5	1.12
334	Straight Pipe	4	120	4	22	0.33	107.02	8.5	1.12
334	Flow Meter			1.5	23	1.50	108.52		
334	Gate Valve	4	0.2		24	0.23	108.75	8.5	1.12
334	Straight Pipe	4	80	10	25	1.72	110.47	8.5	1.12
334	Carbon Column			30	26	30.00	140.47		
334	Straight Pipe	4	80	10	27	1.72	142.19	8.5	1.12
334	Gate Valve	4	0.2		28	0.23	142.42	8.5	1.12
334	Straight Pipe	4	120	4	29	0.33	142.75	8.5	1.12
334	90 Dgr Elbow	4	0.6		30	0.68	143.42	8.5	1.12
334	Straight Pipe	4	120	1.67	31	0.14	143.56	8.5	1.12
334	Increaser	4	1		32	1.13	144.69	8.5	1.12
334	Branch Flow Tee	8	1		33	0.07	144.76	2.1	0.07
1000	90 Dgr Elbow	8	0.6		34	0.38	145.14	6.4	0.64
1000	Straight Pipe	8	120	11	35	0.23	145.37	6.4	0.64
1000	90 Dgr Elbow	8	0.6		36	0.38	145.75	6.4	0.64
1000	Straight Pipe	8	120	4	37	0.08	145.84	6.4	0.64
1000	Gate Valve	8	0.2		38	0.13	145.96	6.4	0.64
1000	Branch Flow Tee	8	1		39	0.63	146.60	6.4	0.64
1000					40				
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THE ADVENT GROUP, INC.

201 SUMMIT VIEW DRIVE
THIRD FLOOR
BRENTWOOD TENNESSEE 37027
615-377-4775
615-377-4976 (Facsimile)

PROPOSAL PROJECT NO. 2011 SHEET 1 OF 1

PROPOSAL PROJECT NAME SCOTT COUNTY COURTHOUSE

BY CLC DATE 01/20/06

CHECKED BY _____ DATE _____

PUMP POWER CALCULATIONS

$P_1 \quad Q = 225 \text{ gpm} \quad \text{T.D.H.} = 50'$

$$h_p = \frac{(225)(50)}{(3956)(0.5)}$$

$$h_p = 5.7$$

$P_2 \quad Q = 100 \text{ gpm} \quad \text{T.D.H.} = 180'$

$$h_p = \frac{(100)(180)}{(3956)(0.5)}$$

$$h_p = 9.1$$

$P_3 \quad Q = 100 \text{ gpm} \quad \text{T.D.H.} = 95'$

$$h_p = \frac{(100)(95)}{(3956)(0.5)}$$

$$h_p = 4.8$$



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BRENTWOOD, TENNESSEE 37027
615-377-4775
615-377-4976 (Facsimile)

PROPOSAL PROJECT NO. 010611 SHEET 1

PROPOSAL PROJECT NAME WATER MAIN

BY ADG DATE 11/20/02

CHECKED BY ADG DATE 11/20/02

HDPE PIPELINE PRESSURE AT EFFLUENT POINT

ASSUME: 7.55" ϕ SDR-17
 $Q = 1000 \text{ gpm}$
10' STATIC HEAD
2' MINOR LOSSES
1,500 FT OF PIPE
 $C = 140$

HAZEN WILLIAMS

$$h_f = 0.002083 L \left(\frac{100}{C} \right)^{1.85} \times \frac{Q^{1.85}}{4.8655}$$

$$h_f = 0.002083 (1,500) \left(\frac{100}{140} \right)^{1.85} \times \frac{1000^{1.85}}{7.55^{4.8655}}$$

$$h_f = 31.8 \text{ ft} + 12 \text{ ft} = 44 \text{ ft}$$

$$P_1 = 225 \text{ gpm} \quad 5.4 \text{ ft} + 44 \text{ ft} \rightarrow 50 \text{ ft}$$

$$P_3 = 100 \text{ gpm} \quad 5.1 \text{ ft} + 44 \text{ ft} \rightarrow 95 \text{ ft}$$



THE ADVENT GROUP, INC.

201 SUMMIT VIEW DRIVE
THIRD FLOOR
BRENTWOOD, TENNESSEE 37027
615-377-4773
615-377-4976 (Fax only)

FINAL PROJECT NO. 0242 SHEET NO. 1
PROPOSAL PROJECT NAME School 15
BY DATE 5/21/97
CHECKED BY DATE

CANISTER SUPPORT

OPERATING WEIGHT 330,000 lbs by Carbon

PIERS 3 - 10' x 10'

RECOMMENDED BY

$$\frac{330,000}{8}$$

$$42,000 \text{ lbs}$$

CHECK SLAB SHEAR

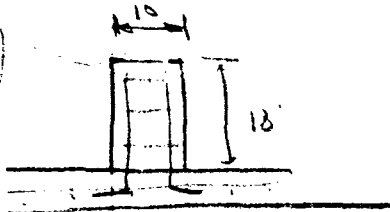
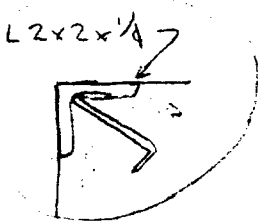
4000 psi conc \rightarrow 110 psi ALLOWABLE

$$\frac{42,000}{110 \text{ psi}}$$

$$380 \text{ IN}^2 = \left(\left(\frac{10}{12} + d \right) 4 \right) (d)$$

$$d = 16 \Rightarrow 334 \text{ IN}^2$$

6" CONC. S-SB ACCEPTABLE





THE ADVENT GROUP, INC.

201 SUMMIT VIEW DRIVE
THIRD FLOOR
BRENTWOOD, TENNESSEE 37027
615-377-4775
615-377-4976 (Facsimile)

PROJECT NUMBER: 2207 SHEET: 1
DIAGRAMAL PROJECT NAME: Calculus
BY: CSB DATE: 20 NOV 87
CHECKED BY: _____ DATE: _____

BACKFLUSH TANK

14' ϕ x 12' H

CHECK UPLIFT

TANK WEIGHT

$$\left[(14^2 \frac{\pi}{4}) + (14 \pi 12) \right] 10.5 \text{ lbs/ft}^2 = 2150 \text{ lbs}$$

MISS RIVER msl = 179.6

GAUGE	379.9
1995 FLOOD	<u>49.5</u>
	429.4
SLAB ELEV	<u>424.0</u>

54 USC 6'

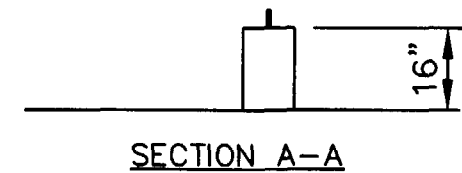
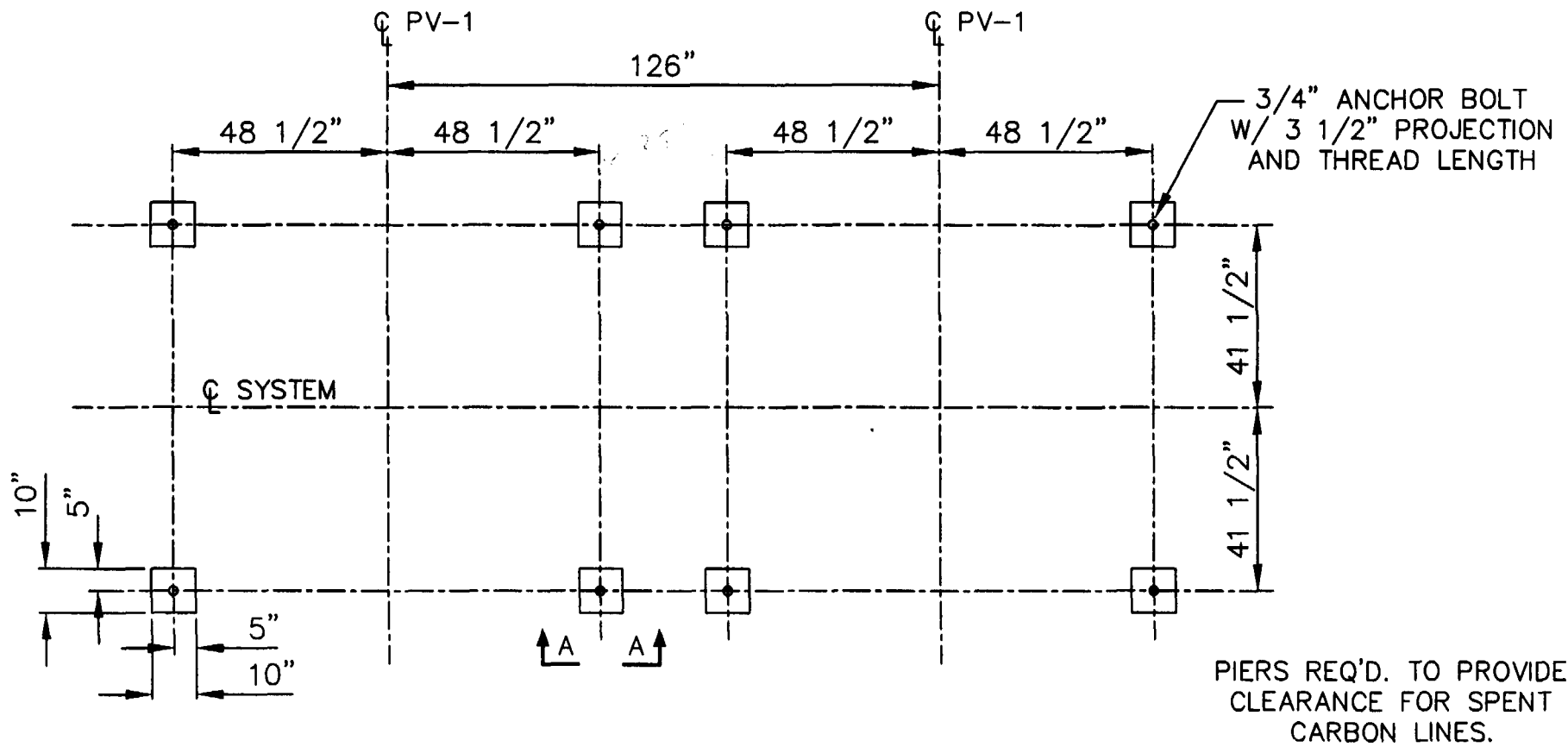
UPLIFT

$$\left[62.4 \text{ lbs/cf} \left(14^2 \frac{\pi}{4} 6 \right) \right] - 2150 \text{ lbs} = 55,500 \text{ lbs}$$

$$\text{SIX ANCHORS} \Rightarrow \frac{55,500}{6} = 9300 \text{ lbs/ANCHOR}$$

$$1" \phi \text{ A.B. (15' EMBEDMENT)} \Rightarrow 12,100 \text{ lbs TENSILE}$$

USE SIX 1" ϕ A.B.



PRELIMINARY EQUIPMENT LIST**CARBON TREATMENT SYSTEM
SOLUTIA KRUMMRICH**

EQUIPMENT NO.	EQUIPMENT NAME	FLOW/ CAPACITY	PRESSURE	HP	REMARKS	RECOMMENDED MANUFACTURER
T-1	Backflush Supply Tank	12,000 gal	Atm	NA	14' D X 12' H, Steel	
V-1A/B	Carbon Adsorption Columns	350 gpm	75 psig	NA	35 psig operating press.	Calgon Dual Module
V-2A/B	Carbon Adsorption Columns	350 gpm	75 psig	NA	35 psig operating press.	Calgon Dual Module
V-3A/B	Carbon Adsorption Columns	350 gpm	75 psig	NA	35 psig operating press.	Calgon Dual Module
V-4A/B	Carbon Adsorption Columns	350 gpm	75 psig	NA	35 psig operating press.	Calgon Dual Module
P-1	Backflush Supply Pump	225 gpm	50' TDH	7.5 hp	1.5 hp consumed	Goulds 3196
P-2	Spray Water Pump	100 gpm	180' TDH	10 hp	8.6 hp consumed	Goulds 3196
P-3	Trailer Dewatering Pump	100 gpm	95' TDH	10 hp	4.6 hp consumed	Goulds 3196
C-1	Transfer Air Compressor	40 acfm	100 psig	10 hp	Centrifugal type	Atlas Copco

	LINE NUMBER	LOCATION		PROCESS					
				DESIGN CONDITIONS					OP
		FROM	TO	PRESS. (psig)	TEMP. (° F)	FLOW (gpm/scfm)	S.G. (s.u.)	VISC. (cP)	PRESS. (psig)
1	12"-HDPE-GW-0101	Site R Collector Wells	Carbon Diversion Vaults	75	120	1,000	1.0	1	
2	8"-CS-CF-0102	8"-HDPE-GW-0101	4"-CS-CF-0202	75	120	1,000	1.0	1	
3	4"-CS-CF-0103	8"-CS-CF-0102	4" HC for V-1A/B carbon feed	75	120	350	1.0	1	
4	4"-CS-CF-0104	8"-CS-CF-0102	4" HC for V-2A/B carbon feed	75	120	350	1.0	1	
5	4"-CS-CE-0105	4" HC for V-1A/B carbon effluent	8"-CS-CE-0107	75	120	350	1.0	1	
6	4"-CS-CE-0106	4" HC for V-2A/B carbon effluent	8"-CS-CE-0107	75	120	350	1.0	1	
7	8"-CS-CE-0107	4"-CS-CE-0203	8"-DI-GW-0209	75	120	1,000	1.0	1	
8	3"-CS-BS-0108	6"-CS-BS-0306	4" HC for V-1A/B backflush supply	25	120	400	1.0	1	
9	3"-CS-BS-0109	6"-CS-BS-0306	4" HC for V-2A/B backflush supply	25	120	400	1.0	1	
10	3"-CS-BR-0110	4" HC for V-1A/B backflush return	6"-CS-BR-0112	25	120	400	1.0	1	
11	3"-CS-BR-0111	4" HC for V-2A/B backflush return	6"-CS-BR-0112	25	120	400	1.0	1	
12	6"-CS-BR-0112	3"-CS-BR-0206	8"-CS-CE-0107	25	120	400	1.0	1	
13	8"-DI-GW-0113	8"-HDPE-GW-0101 (Influent Valve Pit)	8"-HDPE-GW-0101 (Influent Valve Pit)	75	120	1,000	1.0	1	
14	8"-CS-GW-0114	8"-DI-GW-0113	8"-CS-CF-0102	75	120	1,000	1.0	1	
15	4"-CS-CF-0201	8"-CS-CF-0102	4" HC for V-3A/B carbon feed	75	120	350	1.0	1	
16	4"-CS-CF-0202	8"-CS-CF-0102	4" HC for V-4A/B carbon feed	75	120	350	1.0	1	
17	4"-CS-CE-0203	4" HC for V-3A/B carbon effluent	8"-CS-CE-0107	75	120	350	1.0	1	
18	4"-CS-CE-0204	4" HC for V-4A/B carbon effluent	8"-CS-CE-0107	75	120	350	1.0	1	
19	3"-CS-BS-0205	6"-CS-BS-0306	4" HC for V-3A/B backflush supply	25	120	400	1.0	1	
20	3"-CS-BS-0206	6"-CS-BS-0306	4" HC for V-4A/B backflush supply	25	120	400	1.0	1	
21	3"-CS-BR-0207	4" HC for V-3A/B backflush return	6"-CS-BR-0112	25	120	400	1.0	1	
22	3"-CS-BR-0208	4" HC for V-4A/B backflush return	6"-CS-BR-0112	25	120	400	1.0	1	
23	12"-HDPE-GW-0209	Carbon Diversion Vault	P-Chem Facility	75	120	1,000	1.0	1	
24	8"-CS-CE-0210	8"-CS-CE-0107	Outfall	75	120	1,000	1.0	1	
25	8"-CS-CE-0301	8"-CS-CE-0107	Backflush Tank T-1	75	120	1,000	1.0	1	
26	8"-CS-CE-0302	Backflush Tank T-1	Overflow	25	120	400	1.0	1	
27	3"-CS-TW-0303	Backflush Tank T-1	P-3 Suction	25	120	100	1.0	1	
28	6"-CS-BS-0304	Backflush Tank T-1	P-1 Suction	25	120	400	1.0	1	
29	6"-CS-BS-0305	P-1 Discharge	6"-CS-BS-0306	25	120	400	1.0	1	
30	6"-CS-BS-0306	6"-CS-BS-0305	3"-CS-BS-0108, 3"-CS-BS-0206	25	120	400	1.0	1	
31	3"-CS-SW-0307	6"-CS-BS-0304	P-2 Suction	80	120	100	1.0	1	
32	3"-CS-SW-0308	P-2 Discharge	3" HC for carbon vessel spray water	80	120	100	1.0	1	
33	3"-CS-TW-0309	P-3 Discharge	8"-CS-CF-0102	25	120	100	1.0	1	
34	2"-CS-CA-0310	C-1 Receiver Tank	Transfer air stations	100	250	40	0.004	0	30
35	4"-CS-CW-0311	Existing 10" Underground Line	Backflush Tank T-1	75	120	400	1.0	1	55

Service Codes: GW = Grounwater, CF = Carbon Feed, CE = Carbon Effluent, BS = Backflush Supply, BR = Backflush Return, TW = Trailer Water, SW = Spray Water, CA = Compressed Air, CW =

PROCESS HOSE LIST
SOLUTIA KRUMMRICH CARBON TREATMENT SYSTEM
ADVENT PROJECT 02691

Hose No.	Size (in.)	Material	Manufacturer Model	Conn. Type	Length (ft)	Service	Quantity	
							Min.	Rec.
A	4	Thermoplastic Vinyl Nitrile	Royalflex 1196	Aluminum female hose shank	20	Carbon Influent	4	5
B	4	Thermoplastic Vinyl Nitrile	Royalflex 1196	Aluminum female hose shank	20	Carbon Effluent	4	5
C	4	Thermoplastic Vinyl Nitrile	Royalflex 1196	Aluminum female hose shank	20	Backflush Supply	4	5
D	4	Thermoplastic Vinyl Nitrile	Royalflex 1196	Aluminum female hose shank	30	Backflush Return	4	5
E	3	Thermoplastic Vinyl Nitrile	Royalflex 1196	Aluminum female hose shank	100	Spray Water	1	2
F	4	Thermoplastic Vinyl Nitrile	Royalflex 1196	Aluminum female hose shank	80	Trailer Water (Dirty)	1	2
G	4	Thermoplastic Vinyl Nitrile	Royalflex 1196	Aluminum female hose shank	80	Trailer Water (Clean)	1	2
H	4	Thermoplastic Vinyl Nitrile	Royalflex 1196	Aluminum female hose shank	60	Carbon Slurry (Fresh)	1	2
I	4	Thermoplastic Vinyl Nitrile	Royalflex 1196	Aluminum female hose shank	60	Carbon Slurry (Spent)	1	2
J	1 1/2	Medium Oil Resistant	Mainliner	quick disconnect	100	Transfer Air (Skid)	1	2
K	3/4	EPDM	Valuflex Red	quick disconnect	60	Transfer Air (Trailer)	1	2

**NON-INSTRUMENT PROCESS VALVE LIST
SOLUTIA KRUMMRICH CARBON TREATMENT SYSTEM
ADVENT PROJECT 02691**

Service Codes: GW = Grounwater, CF = Carbon Feed, CE = Carbon Effluent, BS = Backflush Supply, BR = Backflush Return, TW = Trailer Water,
SW = Spray Water, CA = Compressed Air

Tag No.	Valve Type	Size (in.)	Line No.	Description	Mfr/Model No. (Note 1)	P&ID No.
GW-V-01	Check	8"	8"-DI-GW-0113	Check valve for groundwater header from wells	Crane Series 373	PID-1
GW-V-02	Gate	8"	8"-DI-GW-0113	Closed to direct flow through carbon system	Crane Series 465 1/2	PID-1
CF-V-03	Gate	8"	8"-CS-CF-0102	Gate valve for carbon system influent header	Crane Series 465 1/2	PID-1
GW-V-04	Gate	8"	8"-CS-CF-0102	Closed to direct flow through filtration system (future)	Crane Series 465 1/2	PID-1
CF-V-05	Gate	3/4"	8"-CS-CF-0102	Bleed valve to drain carbon influent header	Crane Series 490	PID-1
CF-V-06	Ball	4"	4"-CS-CF-0103	Isolation valve for carbon feed line to V-1A/B	Apollo 88-10A	PID-1
CF-V-07	Ball	4"	4"-CS-CF-0104	Isolation valve for carbon feed line to V-2A/B	Apollo 88-10A	PID-1
CE-V-08	Gate	8"	8"-CS-CE-0107	Gate valve for carbon system effluent header	Crane Series 465 1/2	PID-2
CE-V-09	Gate	3/4"	8"-CS-CE-0107	Bleed valve to drain carbon effluent header	Crane Series 490	PID-2
CE-V-10	Ball	4"	4"-CS-CE-0105	Isolation valve for carbon effluent line from V-1A/B	Apollo 88-10A	PID-1
CE-V-11	Ball	4"	4"-CS-CE-0106	Isolation valve for carbon effluent line from V-2A/B	Apollo 88-10A	PID-1
BS-V-12	Ball	3"	3"-CS-BS-0108	Isolation valve for backflush supply line to V-1A/B	Apollo 88-100	PID-1
BS-V-13	Ball	3"	3"-CS-BS-0109	Isolation valve for backflush supply line to V-2A/B	Apollo 88-100	PID-1
BS-V-14	Gate	3/4"	6"-CS-BS-0306	Bleed valve to drain backflush supply header	Crane Series 490	PID-1
BR-V-15	Ball	3"	3"-CS-BR-0110	Isolation valve for backflush return line from V-1A/B	Apollo 88-100	PID-1
BR-V-16	Ball	3"	3"-CS-BR-0111	Isolation valve for backflush return line from V-2A/B	Apollo 88-100	PID-1
BR-V-17	Check	6"	6"-CS-BR-0112	Check valve for backflush return header	Crane Series 373	PID-2
CF-V-18	Ball	4"	4"-CS-CF-0201	Isolation valve for carbon feed line to V-3A/B	Apollo 88-10A	PID-2
CF-V-19	Ball	4"	4"-CS-CF-0202	Isolation valve for carbon feed line to V-4A/B	Apollo 88-10A	PID-2
CE-V-20	Ball	4"	4"-CS-CE-0203	Isolation valve for carbon effluent line from V-3A/B	Apollo 88-10A	PID-2
CE-V-21	Ball	4"	4"-CS-CE-0204	Isolation valve for carbon effluent line from V-4A/B	Apollo 88-10A	PID-2
BS-V-22	Ball	3"	3"-CS-BS-0205	Isolation valve for backflush supply line to V-3A/B	Apollo 88-100	PID-2
BS-V-23	Ball	3"	3"-CS-BS-0206	Isolation valve for backflush supply line to V-4A/B	Apollo 88-100	PID-2
BR-V-24	Ball	3"	3"-CS-BS-0207	Isolation valve for backflush return line from V-3A/B	Apollo 88-100	PID-2
BR-V-25	Ball	3"	3"-CS-BS-0208	Isolation valve for backflush return line from V-4A/B	Apollo 88-100	PID-2

NON-INSTRUMENT PROCESS VALVE LIST
SOLUTIA KRUMMRICH CARBON TREATMENT SYSTEM
ADVENT PROJECT 02691

Service Codes: GW = Grounwater, CF = Carbon Feed, CE = Carbon Effluent, BS = Backflush Supply, BR = Backflush Return, TW = Trailer Water,
 SW = Spray Water, CA = Compressed Air

Tag No.	Valve Type	Size (in.)	Line No.	Description	Mfr/Model No. (Note 1)	P&ID No.
CE-V-26	Gate	8"	8"-CS-CE-0301	Isolation valve for supply line to backflush tank T-1	Crane Series 465 1/2	PID-3
BS-V-27	Gate	6"	n/a	Drain valve for backflush tank T-1	Crane Series 465 1/2	PID-3
TW-V-28	Gate	4"	3"-CS-TW-0303	Isolation valve for P-3 suction line from T-1	Crane Series 465 1/2	PID-3
TW-V-29	Ball	4"	3"-CS-TW-0303	Isolation valve for hose connection to P-3 suction line	Apollo 88-10A	PID-3
TW-V-30	Gate	3/4"	3"-CS-TW-0303	Bleed valve for P-3 suction line	Crane Series 490	PID-3
TW-V-31	Ball	1/2"	3"-CS-TW-0309	Isolation valve for pressure gauge on P-3 discharge line	Apollo 70-103	PID-3
TW-V-32	Check	3"	3"-CS-TW-0309	Check valve for P-3 discharge line	Crane Series 373	PID-3
TW-V-33	Gate	3/4"	3"-CS-TW-0309	Bleed valve for P-3 discharge line	Crane Series 490	PID-3
TW-V-34	Ball	3"	3"-CS-TW-0309	Isolation valve for P-3 discharge line	Apollo 88-100	PID-3
TW-V-35	Ball	4"	3"-CS-TW-0309	Isolation valve for hose connection to P-3 discharge line	Apollo 88-10A	PID-3
BS-V-36	Gate	6"	6"-CS-BS-0304	Isolation valve for P-1/P-2 suction lines from T-1	Crane Series 465 1/2	PID-3
BS-V-37	Gate	4"	6"-CS-BS-0304	Isolation valve for P-1 suction line	Crane Series 465 1/2	PID-3
BS-V-38	Gate	3/4"	6"-CS-BS-0304	Bleed valve for P-1 suction line	Crane Series 490	PID-3
BS-V-39	Ball	1/2"	6"-CS-BS-0305	Isolation valve for pressure gauge on P-1 discharge line	Apollo 70-103	PID-3
BS-V-40	Check	6"	6"-CS-BS-0305	Check valve for P-1 discharge line	Crane Series 373	PID-3
BS-V-41	Gate	3/4"	6"-CS-BS-0305	Bleed valve for P-1 discharge line	Crane Series 490	PID-3
BS-V-42	Gate	6"	6"-CS-BS-0305	Isolation valve for P-1 discharge line	Crane Series 465 1/2	PID-3
SW-V-43	Gate	3"	3"-CS-SW-0307	Isolation valve for P-2 suction line	Crane Series 465 1/2	PID-3
SW-V-44	Gate	3/4"	3"-CS-SW-0307	Bleed valve for P-2 suction line	Crane Series 490	PID-3
SW-V-45	Ball	1/2"	3"-CS-SW-0308	Isolation valve for pressure gauge on P-2 discharge line	Apollo 70-103	PID-3
SW-V-46	Check	3"	3"-CS-SW-0308	Check valve for P-2 discharge line	Crane Series 373	PID-3
SW-V-47	Gate	3/4"	3"-CS-SW-0308	Bleed valve for P-2 discharge line	Crane Series 490	PID-3
SW-V-48	Ball	3"	3"-CS-SW-0308	Isolation valve for P-2 discharge line	Apollo 88-100	PID-3
CA-V-49	Ball	2"	2"-CS-CA-0310	Isolation valve for 30# air connection from C-1	Apollo 70-108	PID-3
CA-V-50	Ball	2"	2"-CS-CA-0310	Isolation valve for 15# air connection from C-1	Apollo 70-108	PID-3

**NON-INSTRUMENT PROCESS VALVE LIST
SOLUTIA KRUMMRICH CARBON TREATMENT SYSTEM
ADVENT PROJECT 02691**

Service Codes: GW = Grounwater, CF = Carbon Feed, CE = Carbon Effluent, BS = Backflush Supply, BR = Backflush Return, TW = Trailer Water,
SW = Spray Water, CA = Compressed Air

Tag No.	Valve Type	Size (in.)	Line No.	Description	Mfr/Model No. (Note 1)	P&ID No.
GW-V-51	Butterfly	8"	8"-DI-GW-0113	Manual control valve to regulate flow to backup GAC system	Crane Series 42	PID-1
CE-V-52	Globe	8"	8"-CS-CE-0301	Level control valve for backflush supply tank T-1	OCV Model 8000LDM	PID-3
CE-V-53	Gate	8"	8"-CS-CE-0210	Gate valve to start/stop flow to Outfall	Crane Series 465 1/2	PID-2

Notes:

1. Listed manufacturers and models are one of the possible selections. 15222
See Section 15222 for a complete listing.

CARBON TREATMENT SYSTEM MOTOR LIST AND ELECTRICAL REQUIREMENTS
SOLUTIA KRUMMRICH
ADVENT PROJECT 02607

Tag #	Item	# of Units	Speed rpm	Voltage			hp per Unit	Connected Load	
				V	phase	Hz		hp	kW
P-1	Backflush Supply Pump	1	1800	460	3	60	7.5	7.5	5.6
P-2	Spray Water Pump	1	1800	460	3	60	10	10	7.5
P-3	Trailer Dewatering Pump	1	3500	460	3	60	10	10	7.5
C-1	Carbon Transfer Air Compressor	1	--	460	3	60	10	10	7.5
	Lighting	4	--				0.25	1	0.7
	Heat Tracing	200					0.0054	1	0.8
TOTAL:								40	29.5
OPERATING:								18	13.2

CARBON COLUMN DATA SPECIFICATION SHEET

Item No:	V-1A/B through V-4A/B	Project No.:	02691	Spec. No.:	
Description:	Carbon Treatment System	Project:	Carbon Trt. Sys.	Location:	Sauget, IL

GENERAL



The Activated Carbon Adsorption System will be designed for the removal of soluble organic chemical contaminants. The unit will be a complete water treatment system and be provided with piping for parallel or series operation. The unit will come equipped with piping sections and manual valves for influent and treated water, carbon transfer, and venting operations.

The units will be skid-mounted and be configured to give a working height of less than 16 feet.

SPECIFICATIONS

Qty.:	4 dual trains (1 lead, 1 lag column ea.) with ea. train operating in series		
Vessel Diameter:	10 ft		
Heads:	2:1 Elliptical		
ASME Code:	Up to 75 psig @ 150 deg. F		
Pipe Connections:	Std ANSI flanged connections (see nozzle schedule)		
Carbon Volume:	715 cu ft		
Weight (per dual train):	Empty - 57,000 lb	/	Operating - 330,000 lb
Backflush Rate: (per column)	225 gpm		
Transfer Mode:	Air pressurized slurry transfer by supply truck		
Operation Modes:	Downflow fixed bed with backflush capabilities Parallel or series flow		
Max Flow: (per column)	470 gpm	Avg. Flow: (per column)	200 gpm
Process Conditions			
TSS:	< 15 mg/L		
TOC:	300 mg/L		
Materials of Construction	Vessel:	Carbon Steel (ASTM A-36)	
	Vessel Lining:	Vinyl Ester coating (nominal 40 mil)	
	Piping and Valves:	Carbon steel piping (std. wt. ASTM A-53), ductile iron butterfly valves with stainless steel disc for process piping and stainless steel ball valves for carbon transfer	
	Underdrain Collection System:	Internal ring underdrain or equivalent to ensure equal flow distribution.	
	External Coating:	Surf. prep acc. to SSPC-SP6; Prime coat alkyd phenolic primer 2-3.5 mDFT Top coat alkyd enamel, 2 coats at 1.5-3.5 mDFT per coat (Primer - Tnemec series 37, Top coat - Tnemec series 2H or equivalents)	
Pressure Relief	Graphite rupture disk or equivalent, 75 psig burst pressure (1 per column).		
Instrumentation / Control System	All process valves will be operated manually.		

(Continued Next Page)

PREPARED ON BEHALF OF Solutia, Inc.				Rev.:	C	Date:	7/23/03	Prepared By:	ATL
C	Contingency Plan					 Solutia, Inc. St. Louis, MO			
B	Pre-Final Design								
A	For Review								
ISSUE	DESCRIPTION	APP'D	CLIENT						

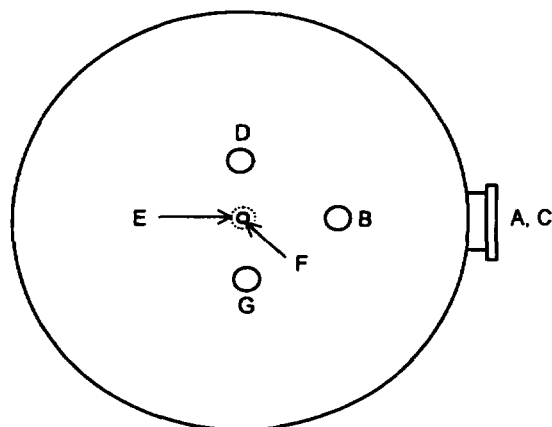
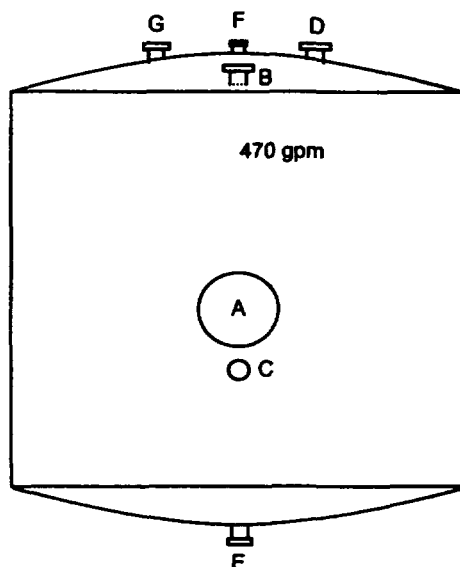
CARBON COLUMN DATA SPECIFICATION SHEET



Item No:	V-1A/B through V-4A/B	Project No.:	02691	Spec. No.:	
Description:	Carbon Treatment System	Project:	Carbon Trt. Sys.	Location:	Sauget, IL

NOZZLE SCHEDULE

#	Location	Size	Flange Type
A	Side Manway	20"	F.F.
B	Process In	4"	150# F.F.
C	Process Out/BF In	4"	150# F.F.
D	Carbon In	4"	150# F.F.
E	Carbon Out	4"	150# F.F.
F	Spray Water	3"	150# F.F.
G	Vent/BF Out	4"	150# F.F.

Note: Nozzle locations shown are for Vessel 1.
Vessel 2 nozzle locations will be mirror image.



PREPARED ON BEHALF OF Solutia Inc.				Rev.: C	Date: 7/23/03	Prepared By: ATL
C	Contingency Plan			 The ADVENT Group, Inc.	 Solutia Inc. St. Louis, MO	
B	Pre-Final Design					
A	For Review					
ISSUE	DESCRIPTION	APP'D	CLIENT			

CALGON CARBON CORPORATION

DUAL MODULE CARBON ADSORPTION SYSTEM


Calgon Carbon Corporation
P.O. Box 717
Pittsburgh, PA 15230

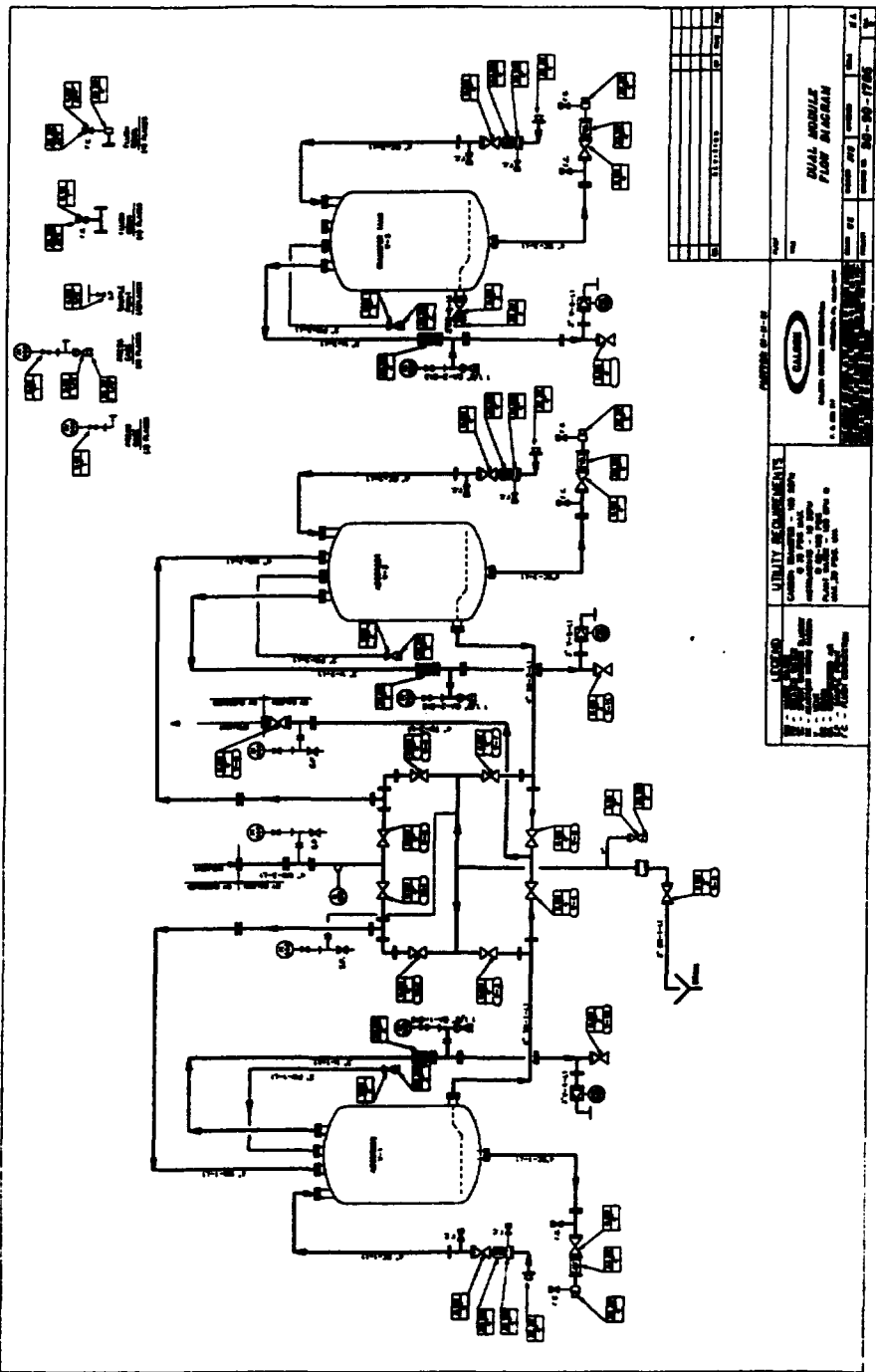
SYSTEM DESCRIPTION

- Vessels**
- Two (2) 10'-0" diameter by 8'-0" straight side height
 - Flanged and dished top and bottom heads
 - Overall height approximately 14'-0"
 - Design pressure 75 psig at 150 degrees F
 - Skid mounted system (Vessels and piping).
 - One (1) 20" diameter flanged round manway on the lower side portion of the vessel.
 - Polypropylene header/lateral underdrain system provided with polypropylene nozzles.
 - Interior of the vessel will be lined with Plasite 4110, vinyl ester lining.
 - Overall installed dimensions 20'-0" long X 14'-0" high (Clear Height) X 11'-2" wide
 - Approximate weight 57,000 pounds empty and 330,000 pounds operating.
- Piping**
- The influent, effluent and backwash piping 3" diameter schedule 40 carbon steel polypropylene lined in accordance with ASTM 53 grade B.
 - The carbon fill and discharge piping 4" diameter schedule 40 carbon steel polypropylene lined in accordance with ASTM 53 grade B.
- Valves**
- The main influent and effluent valves are TFE lined Plug valves, wrench operated, ductile iron body with 150-pound ANSI B16.5 flanged ends. A total of eight (8) plug valves will be provided for the main process operations. Four (4) for backwash control, two (2) for the main influent, two (2) for the effluent and two (2) for the vent valves.
 - The carbon inlet and outlet valves 4 inch TFE lined Plug valves wrench operated, ductile iron body with 150 pound ANSI B16.5 flanged ends. (Total of four (4) valves).
- Instrumentation**
- One (1) 3" rupture disc per vessel (A total of two (2)).
 - Five (5) pressure gauges total.

CALGON CARBON CORPORATION

- Painting** - Exterior surface preparation SSPC-SP2-63, two (2) coats of epoxy mastic paint (Sherwin Williams B58 Series).
- Sight Glasses** - Sight glasses are provided in the carbon exchange and vent piping on each adsorber. (A total of four (4) sight glasses).
- Steel Skid** - The system is provided with a painted carbon steel skid for mounting of the piping and vessels. The vessels will be provided with four (4) structural steel supports legs.

FIGURE 4-22-23  CALSONIC CALSONIC COMPANY CORPORATION 1000 W. 10th St. FARMINGTON, CT 06030		Part # _____ Qty _____ Unit _____ DUAL MODULE	
Part # _____ Qty _____ Unit _____ DUAL MODULE	Part # _____ Qty _____ Unit _____ DUAL MODULE	Part # _____ Qty _____ Unit _____ DUAL MODULE	Part # _____ Qty _____ Unit _____ DUAL MODULE



REVISIONS	
NO.	DESCRIPTION
1	INITIAL

QUALITY ASSURANCE
CHECKED BY: [Signature]
DATE: 10-10-1965

UNIT REQUIREMENTS
FUEL SYSTEM
FUEL TANKS
FUEL PUMPS
FUEL VALVES
FUEL LINES
FUEL FILTERS
FUEL METERING DEVICES

LEGEND
FUEL TANK
FUEL PUMP
FUEL VALVE
FUEL LINE
FUEL FILTER
FUEL METERING DEVICE



DUAL MODULE CARBON ADSORPTION SYSTEM

DESCRIPTION

The Calgon Carbon Dual Module is an adsorption system designed for the removal of dissolved organic contaminants from liquids using granular activated carbon (GAC). The pre-piped, skid mounted configuration is designed for on-site treatment where the need is periodic or where a permanent system would be uneconomical.

The Dual Module system is delivered as two pre-piped adsorbers on a skid. Installation, piping connections and start-up are supervised by Calgon Carbon personnel. The Dual Module is ideal for emergency response situations and usually can be dispatched to a site within 24-48 hours. Start-up can begin within hours of the arrival of the unit at the site.

When the carbon becomes exhausted, the Dual Module is designed for fresh carbon replacement utilizing Calgon Carbon's closed loop carbon exchange service. Using special designed trailers, spent carbon is removed from the adsorbers and returned to Calgon Carbon for reactivation. The trailers also recharge the adsorbers with fresh carbon, minimizing downtime.

FEATURES AND BENEFITS

- **Versatility** - The Dual Module utilizing activated carbon adsorption is effective for removing a wide spectrum of organic compounds, in high or low concentrations, and a wide range of flows.
- **Rapid Response** - Dual Modules are pre-piped and "ready to go" on short notice, as quickly as 24-48 hours, to respond to your needs, even on an emergency basis.
- **Cost Effective** - Calgon Carbon provides the equipment, activated carbon, and supervision for only as long as needed, avoiding permanent system purchases costs and ongoing maintenance.
- **Environmental Compliance** - Carbon adsorption is a proven and flexible technology for treating contaminated groundwater, spills or lagoon wastewater, eliminating the threat to plant and animal life or potable water supplies, and meeting discharge requirements.

SYSTEM SPECIFICATIONS

Carbon adsorbers:

- Carbon steel ASME code pressure vessels.
- Internal vinyl-ester lining (nominal 35 mil) for potable water and most liquid applications.
- Polypropylene (PPL) underdrain and slotted nozzles for water collection.

Standard adsorption system piping:

- Schedule 40 3" or 4" PPL lined carbon steel process piping.
- Tetrafluorethylene (TFE) lined plug valves for process piping.
- PPL lined steel pipe for GAC discharge.
- TFE lined plug valves for GAC fill and discharge.

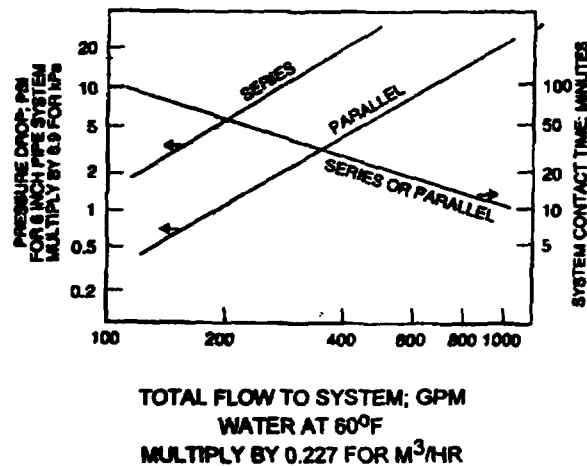
System external coating:

- Epoxy mastic or polyurethane paint system.



OPERATING CONDITIONS

Carbon per adsorber	20,000 lbs. (9080 kg)
Pressure rating	75 psig (517 kPa)
Pressure relief	Graphite rupture disk (75 psig)
Vacuum rating	14 psig
Temperature rating	150°F maximum (65°C)
Carbon transfer	Air pressure slurry transfer
Utility air, for carbon transfer	100 scfm at 30 psig (reduce to 15 psig for trailer)
Utility water	100 gpm at 30 psig
Freeze protection	None provided; enclosure or protection recommended



DIMENSIONS AND FIELD CONNECTIONS

Adsorber vessel diameter	10 ft (3050 mm)
Process pipe	3 in. or 4 in.
Process pipe connection	125# ANSI flange
Utility water connection	2.0 in. threaded connection
Utility air connection	1.5 in threaded connection
Carbon hose connection	4 in. Kamlock type
Vent connection	3 in. flange
Adsorber maintenance access	20 in. round flanged man-way
Adsorber shipping weight	40,000 lbs. (empty) (18,160 kg)
System operating weight	160,000 lbs. (72,529 kg)

SYSTEM DIMENSIONS

Length.....21 ft.
Width12 ft.
Height (on support)15 ft.



The Dual Module is specifically designed for medium or large flow applications. Calgon Carbon Corporation offers a wide range of carbon adsorption systems and services for smaller flows and carbon usages to meet specific applications.

CAUTION

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low-oxygen spaces should be followed, including all applicable federal and state requirements.

SAFETY MESSAGE

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable federal and state requirements.

1-800-4-CARBON**www.calgoncarbon.com****Domestic Sales Offices****East Coast Region**

Flemington, NJ 08822-5712
Tel (908) 237-4800
Fax (908) 237-4846

Midwest Region
Pittsburgh, PA
Tel (412) 787-8700
1-800-4-CARBON
Fax (412) 787-8678

West Coast and Rockies Region

Monterey, CA 93940-6372
Tel (831) 856-1850
Fax (831) 856-1856

Gulf Coast Region
Houston, TX 77082-8815
Tel (713) 690-2000
(713) 686-9880
Fax (713) 690-7909

**CALGON CARBON CORPORATION****International Sales Offices****Australasia / Philippines / Southeast Asia**

Calgon Carbon Asia
Singapore Office
Tel (65) 221-3500
Fax (65) 221-3554

Canada

Calgon Carbon Canada, Inc.
Bolton, Ontario
Tel (905) 857-9915
Fax (905) 857-9984

China / Korea / Taiwan

Calgon Carbon Asia
Tokyo Office
Tel 81 3 3560 7505
Fax 81 3 3584 7202

Europe

Chemviron Carbon
Zoning Industriel de Feluy
B-7181 Feluy, Belgium
Tel 32 64 51 18 11
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Japan

Calgon Far East
Tokyo Office
Tel 81 3 3582 1861
Fax 81 3 3586 9286

Latin America

Houston, TX 77082-8815
Tel (713) 690-2000
(713) 686-9880
Fax (713) 690-7909

Calgon Carbon Corporation's activated carbon products are continuously being improved and changes may have taken place since this publication went to press.

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DSR-C 8x30 GRANULAR REACTIVATED CARBON

DESCRIPTION

DSR-C is a grade of reactivated carbon designed for the removal of organic contaminants from industrial wastewater or process water. The carbon is manufactured by the reactivation of bituminous coal-based virgin and reactivated products to produce a high-density, high surface area durable product capable of withstanding repeated cycles of use and reactivation.

DRS-C is effective in a wide range of applications and fluctuating flows providing reliable removal of dissolved organic compounds.

DRS-C is screened prior to packaging to insure consistent performance and low pressure drop. DRS-C is not to be used for food grade or potable applications.

APPLICATIONS

- Point source treatment to remove chemicals
- Pre-treatment to biological waste treatment systems
- Product recovery from wastewater
- Recycling wastewater
- Polishing effluent from biological waste treatment systems
- Providing total wastewater treatment

DESIGN CONSIDERATIONS

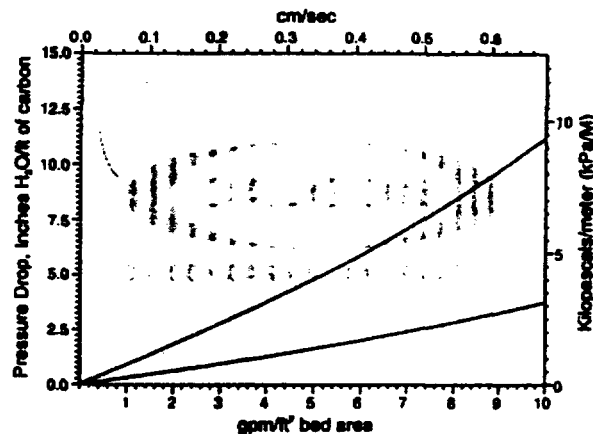
The design of an activated carbon adsorption system is dependent on the adsorbate type, influent concentration, temperature, flow rate, performance objective, and other factors. Calgon Carbon has experience designing systems and can help evaluate the suitability of DSR-C to satisfy specific needs and assist in the design of an adsorption system. In addition to the supply of activated carbon, Calgon Carbon offers a complete line of standardized, pre-engineered adsorption systems. For additional information on adsorption capacity of organic compounds, please contact the Calgon Carbon Technical Sales Representative for your area.

SPECIFICATIONS

Iodine No. mg/g:	800 min
Screen distribution: <30 U.S. mesh	5% max
Ash content:	9% max
Moisture, wt% as packed:	2% max
Apparent Density, g/cc:	0.60 max

PRESSURE DROP

Liquid down-flow through DSR-C 8x30 Carbon



PACKAGING	MANUFACTURING
1000 lb. Super Sacks, bulk	Catlettsburg, KY

DRS-C is not for use in potable water or food grade applications.

If at any time our products or services do not meet your requirements or expectations, or if you would like to suggest any ideas for improvement, please call us at 1-800-548-1399. From outside the U.S. please call +1-412-787-6700.

FEATURES	BENEFITS
<u>Raw Material:</u>	
<ul style="list-style-type: none"> Metallurgical grade, bituminous coal based 	<ul style="list-style-type: none"> Produces a strongly adsorbing pore structure for a broad range of contaminants and concentrations.
<u>Miscellaneous:</u>	
<ul style="list-style-type: none"> Reactivated product Recyclable product High surface area/pore structure Product is screened prior to packaging 	<ul style="list-style-type: none"> Economical alternate to virgin carbon. Provides ultimate disposal of pollutants. Eliminates landfill costs and concerns. Propagates the cycle of responsible resource utilization. Efficient in removing a wide range of dissolved organic compounds. Reliable - accommodates variations in flows or concentrations. Results in less fines and lower pressure drop. Minimizes backwashing.

PRODUCT OPTIONS

In addition to DSR-C, Calgon Carbon offers a variety of products and services to meet your treatment requirements:

Granular Carbon Products	Service Products
<ul style="list-style-type: none"> Filtrosorb 300 & 400 - virgin liquid phase products. 	<ul style="list-style-type: none"> Technical services including design assistance, calculations of carbon use rates, laboratory and

- React pH - for pH sensitive applications.
- React AW - for acid purification.

Equipment Products

- Standardized, pre-engineered adsorption systems capable of treatment flows from 1 gpm to 1400 gpm.
- Custom engineered systems - to meet unique treatment requirements.

- pilot studies, start-up and operations assistance.
- On-site exchange services and reactivation service reduce labor requirements and minimize disposal cost.

SAFETY MESSAGE

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable federal and state requirements.

1-800-4-CARBON

www.calgoncarbon.com

Domestic Sales Offices

East Coast Region

Flemington, NJ 08822-6712
Tel (908) 237-4800
Fax (908) 237-4848

Midwest Region
Pittsburgh, PA
Tel (412) 787-6700
1-800-4-CARBON
Fax (412) 787-6676

West Coast and Rockies Region

Monterey, CA 93940-5372
Tel (831) 656-1650
Fax (831) 656-1656

Gulf Coast Region
Houston, TX 77092-8815
Tel (713) 690-2000
(713) 686-8690
Fax (713) 690-7909

International Sales Offices

Australasia / Philippines /

Southeast Asia
Calgon Carbon Asia
Singapore Office
Tel (65) 221-3500
Fax (65) 221-3554

Canada
Calgon Carbon Canada, Inc.
Bolton, Ontario
Tel (905) 857-9915
Fax (905) 857-9984

China / Korea / Taiwan
Calgon Carbon Asia
Tokyo Office
Tel 81 3 3560 7505
Fax 81 3 3584 7202

Europe

Chemviron Carbon
Zoning Industriel de Feluy
B-7181 Feluy, Belgium
Tel 32 64 51 18 11
Fax 32 64 54 15 91

Japan

Calgon Far East
Tokyo Office
Tel 81 3 3582 1861
Fax 81 3 3586 9286

Latin America

Houston, TX 77092-8815
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CALGON CARBON CORPORATION

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CENTRIFUGAL PUMP DATA SHEET

Item No: <u>P-1</u>		Project No.: <u>02691</u>		Spec. No.:	
Description: <u>Backflush Supply Pump</u>		Project: <u>Carbon Trf. Sys.</u>		Location: <u>Saugeel, IL</u>	

OPERATING CONDITIONS

CAPACITY, NORMAL 225 (GPM) RATED 225 (GPM)

DISCHARGE PRESS 21.6 (psig)

SUCTION PRESS MAX/RATED / (psig)

DIFFERENTIAL PRESS / (psig)

DIFFERENTIAL HD 50 (ft.)

NPSH AVAIL 3.7 (FT) HYDRAULIC POWER / (whp)

SERVICE: ☒ CONTINUOUS ☐ INTERMITTENT (STARTS/DAY /)

LIQUID Groundwater

TEMP 50 (°F) MAX 75 (°F)

S.G. 1.0 VISCOSITY @ MAX P.T. 1.122 (cp)

VAP. PRESS @ MAX PT. 0.26 (psia) CORR/EROS BY /

PERFORMANCE

PROPOSAL CURVE NO. /

NO. STAGES / SPEED / RPM

RATED EFF. / % RATED POWER / BHP

MAX POWER RATED IMPELLER / BHP

MAX HD RATED IMPELLER / FT

MINIMUM CONTINUOUS FLOW THERMAL / GPM

NPSH REQ'D (H₂O) / (FT) STABLE / GPM

ROTATION (FROM CPLG END): /

REMARKS: /

CONSTRUCTION

NOZZLES	SIZE	ANSI RATING	FACING	POSITION
SUCTION	<u>4</u>	<u>A40</u>	<u>F.F.</u>	<u>Horiz.</u>
DISCHARGE	<u>3</u>	<u>/</u>	<u>F.F.</u>	<u>Vert.</u>

SERVICE CONNECTIONS	NO.	SIZE	TYPE
CASING DRAIN	<u>1</u>	<u>/</u>	<u>/</u>
VENT	<u>/</u>	<u>/</u>	<u>/</u>
PRESS GAUGE	<u>/</u>	<u>/</u>	<u>/</u>
WARM UP	<u>/</u>	<u>/</u>	<u>/</u>

CASE:

TYPE: ☒ END SUCTION ☐ VERTICAL ☐ SUMP

☐ DBL SUCTION ☐ MULTI STAGE

☐ VERTICAL ☐ CANTILEVER

SPLIT: ☐ AXIAL ☐ RADIAL

MOUNTING: ☒ FOOT ☐ IN LINE

☐ CENTERLINE ☐ VERTICAL

☐ OTHER /

PRESS. MAWP / PSIG @ / °F

MAWP / PSIG @ PUMPING TEMP.

STUFFING BOX: ☐ STD BORE ☒ LARGE BORE

☐ TAPERED BORE ☐ JACKETED

IMPELLER MTG: ☐ INDIVIDUALLY SECUR ☐ OVERHUNG

☐ BETWEEN BEARINGS

ROTATION (VIEWED FROM COUPLING END): ☐ CW ☐ CCW

SHAFT:

DIA. @ SLEEVE / (in.), COUPLING / (in.)

DIA. BETWEEN BRGS. / (in.)

SPAN BETWEEN BRG CENTERLINE / (in.)

SPAN BETWEEN BRG & IMPELLER / (in.)

COUPLINGS:

MAKE / MODEL /

RATING (HP/100 RPM) /

LUBRICATION /

LIMITED END FLOAT REQ'D /

SPACER LENGTH / (in.) SERV. FACTOR /

DYNAMIC BALANCED AGMA BLANCE CLASS ☐ PUMP MFR.

☐ DRIVER ☐ PURCHASER ☐ CPLG PER API 671

REMARKS: /

MATERIALS

TABLE H-1 CLASS /

BARREL/CASE / IMPELLER 316 SS

CASE/IMPELLER WEAR RINGS /

SHAFT CS SLEEVE 316 SS

DIFFUSERS / COUPLING HUBS /

COUPLING SPACER/DIAPHRAGMS /

BASEPLATE NO./MATL. / Cast Iron

☐ VERTICAL LEVELING SCREWS

☐ HORIZONTAL POSITIONING SCREWS

STUFFING BOX /

BEARINGS AND LUBRICATION

BEARING: (TYPE/NO.) /

RADIAL /

THRUST /

LUBRICATION

☐ GREASE ☒ OIL FLOOD ☐ RING OIL

☐ FLINGER ☐ PURGE OIL MIST ☐ PURE OIL MIST

☐ CONSTANT LEVEL OILER

☐ PRESSURE ☐ API-611 ☐ API-614

☐ OIL VISCOSITY, GRADE /

OIL HEATER REQ'D ☐ ELECT. / ☐ STEAM

MOTOR DRIVE

MFR / HP 2.5

RPM 1800 FRAME / SF 1.15

☒ HORIZONTAL ☐ VERTICAL

VOLTS/PHASE/HERTZ 480 3 60

TYPE / ENCLOSURE TEFC

INSULATION F BEARINGS /

LUBE / TEMP RISE /

MIN. STARTING VOLTAGE / FULL LOAD AMPS /

LOCKED ROTOR AMPS /

STARTING METHOD /

VERTICAL THRUST CAP

UP / (lbs.)

DOWN / (lbs.)

REMARKS NON-OVERLOADING MOTOR REQUIRED

Revision: C

Date: 7/23/03

Sheet 1 of 1

Prepared By: MMH

ISSUE	DESCRIPTION	CHKD	APPD	CLIENT
<u>C</u>	<u>Contingency Plan</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>B</u>	<u>Prelim Design</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>A</u>	<u>For Review</u>	<u>/</u>	<u>/</u>	<u>/</u>

The ADVENT Group, Inc.

Solutia Inc.
St. Louis, MO

Goulds Pumps



ITT Industries

Phil Brasher

Proposal No: PB211002

Item No: ITEM001

Nov 20, 2002

MODEL:3196 Size: 3x4-8G MTX QTY: 1

Operating conditionsSERVICE
LIQUID*Water Temp. 60.0 deg F, Vapor Pres. 0.26 psi abs, SP.GR 1.000 ,
Viscosity 1.122 cp*CAPACITY Norm./Rate
HEAD*225.0 / 225.0 gpm
50.0 ft***Performance at 1750 RPM**

PUBLISHED EFFY

69.0% (CDS)

RATED EFFY

65.5% with contract seal

RATED POWER

4.3 hp (incl. Mechanical seal drag 0.22). (Run out 5.0 hp)

NPSHR

3.7 (ft)

DISCH. PRESSURE

21.6 (26.0 @ Shut off) (psi g)

PERF. CURVE

1590-2 (Rotation CW viewed from coupling end)

SHUT OFF HEAD

60.1 ft

MIN FLOW

*75.0 (gpm)***PRICE IN USD**

Pump Unit	Incl
Driver	Incl
Boxing	

Testing	
Freight	
Accessories	
Total 1 Unit	5,231

Materials

CONSTRUCTION

Ductile iron with 316SS impeller

CASING

Ductile iron

ST. BOX COVER

Ductile iron

IMPELLER

316SS - Open (7.5000 rated (in) max=8.3750 min=5.5000)

CASING GASKET

Aramid Fiber with EPDM Rubber

IMPELLER O-RING

Teflon

SHAFT

SAE 4140

SHAFT SLEEVE

316SS

LUBRICATION

Flood oil

SEAL CHAMBER

Standard non cooled

BEARINGS

SKF 6309 (Inboard Bearing) SKF 5309 A/C3 (Outboard Bearing)

COUPLING

T.B. Wood's-SC 6-

COUPLING GUARD

Carbon steel

BASEPLATE

*Cast iron camber top***Sealing Method**

MECHANICAL SEAL

*Burgmann - Cartex - Carbon Vs Silicon Carbide EPDM - (Cartridge-Single)***Flanges***150# flat face***Liquid end features***Impeller static balance to ISO G6.3***Frame features***Ductile iron frame adapter***Piping***CPI plan 7301 armored Teflon hose A-20 Fittings***Painting***Goulds Blue water reducible coating (Strathmore)***Noise level Data***Maximum predicted sound pressures level pump only in Decibels (db) Re 0.0002 microbars measured 3ft horizontally
and 5ft from the floor per QCP 580*

31.5		63		125		250		500		1k		2k		4k		8k		A	
59.0		60.0		61.0		63.0		62.0		61.0		60.0		60.0		57.0		67.5	

Octave Band Center Freq.-Hz.

Proposal No: PB211002

Item No: ITEM001

MODEL: 3196

MTX 3x4-8G

Page2

Driver: Electric motor Manufacturer: Pump mfg 's Choice

FURNISHED BY

Pump mfg

RATING

7.50 hp (5.6 KW)

HASE/FREQ/VOLTS

3/60 Hz/230/460

INSULATION/SF

F/1.15

MOUNTED BY

Pump mfg

ENCLOSURE

TEFC Premium Efficiency

SPEED

1800 RPM

FRAME

213T

Weights

TOTAL NET UNIT WEIGHT

493.01b

Program Version 2.3.0.0

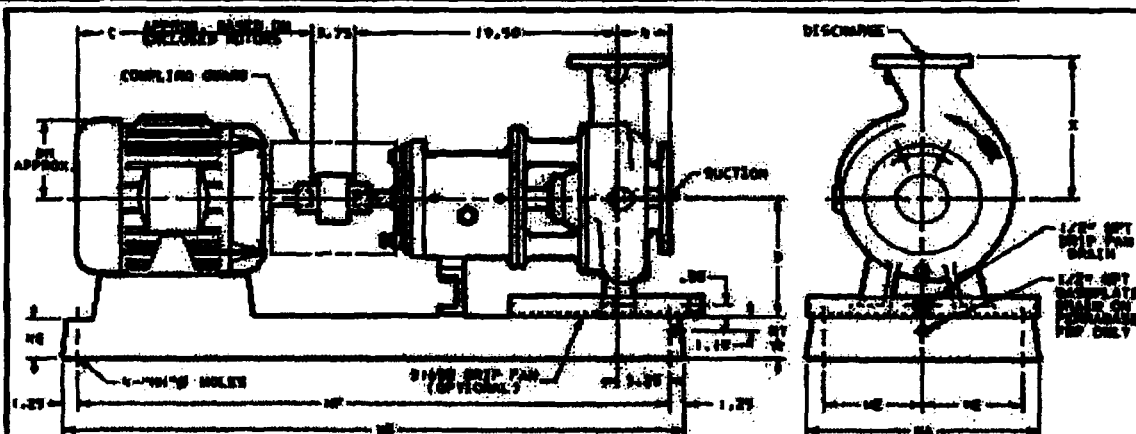


Model 3196 MTX, LTX

Dimensional Prints - Pump Outline Drawing

725.1A628

October 26, 1998
(Sup. 8/14/98)



MOTOR DIMENSIONS (TEFC)					
MOTOR		C	D	HT. TPO CFL.	SHAFT HT.
SIZE	1/2"				
5A	50	11	4	50	1
1401	500	13	4	50	2
1402	500	14	4	50	1
1427	1000	15	5	50	1
1404	3125	16	5	75	1
2101	1000	18	6	100	1
2401	1500	20	6	100	1
2402	1500	21	7	100	2
2403	1500	24	7	100	2
2404	1500	26	8	125	2
2405	3000	28	8	125	2
2406	1000	27	8	150	2
2407	3000	30	9	150	2
2408	3000	31	9	175	2
2409	3000	32	9	175	2
2410	3000	33	9	175	2
2411	3000	34	10	200	2A
2412	3000	35	10	200	2A
2413	3000	36	10	200	2A
2414	3000	37	11	225	4
2415	3000	39	11	225	4
2416	3000	40	11	225	4
2417	3000	41	11	225	4
2418	3000	42	11	225	4
2419	3000	43	11	225	4
2420	3000	44	11	225	4
2421	3000	45	11	225	4
2422	3000	46	11	225	4
2423	3000	47	11	225	4
2424	3000	48	11	225	4
2425	3000	49	11	225	4
2426	3000	50	11	225	4
2427	3000	51	11	225	4
2428	3000	52	11	225	4
2429	3000	53	11	225	4
2430	3000	54	11	225	4
2431	3000	55	11	225	4
2432	3000	56	11	225	4
2433	3000	57	11	225	4
2434	3000	58	11	225	4
2435	3000	59	11	225	4
2436	3000	60	11	225	4
2437	3000	61	11	225	4
2438	3000	62	11	225	4
2439	3000	63	11	225	4
2440	3000	64	11	225	4
2441	3000	65	11	225	4
2442	3000	66	11	225	4
2443	3000	67	11	225	4
2444	3000	68	11	225	4
2445	3000	69	11	225	4
2446	3000	70	11	225	4
2447	3000	71	11	225	4
2448	3000	72	11	225	4
2449	3000	73	11	225	4
2450	3000	74	11	225	4
2451	3000	75	11	225	4
2452	3000	76	11	225	4
2453	3000	77	11	225	4
2454	3000	78	11	225	4
2455	3000	79	11	225	4
2456	3000	80	11	225	4
2457	3000	81	11	225	4
2458	3000	82	11	225	4
2459	3000	83	11	225	4
2460	3000	84	11	225	4
2461	3000	85	11	225	4
2462	3000	86	1		

SAMPLATE DIMENSIONS													
NO.	HA	HP	CART		FWD		CART		FWD		WE	WT	WV
			INCH	MM	INCH	MM	INCH	MM	INCH	MM			
1	12	49	4.19	107	4.19	107	3.75	95	4.30	109	.75	193	94
2	19	52	4.50	114	4.50	114	4.31	110	4.50	114	.75	193	94
3	19	49	4.10	104	4.10	104	4.74	120	4.50	114	1.00	254	76
4	19	48	4.10	104	4.10	104	4.75	120	4.50	114	1.00	255	77
5	19	50	4.19	107	4.19	107	4.75	120	4.50	114	1.00	256	76
6	19	50	4.19	107	4.19	107	4.75	120	4.50	114	1.00	256	76

FLYING DUTCHMANS						
APR. NO.	WEEK. SIZE	SPR. SIZE	SPR. PRICE	2	3	4 DUT.
470	3	4	7	5.25	11.00	240
482	3	5	8	5.25	9.50	220
476	3	4	8	5.25	11.00	240
478	3	4 1/2	8	5.25	11.00	240
485	1	3	10	5.25	8.50	220
474	1 1/2	3	10	5.25	8.50	240
484	3	5	10	5.25	9.50	270
475	3	4	10	5.25	11.00	240
480	3	4	10 1/2	12.00	12.50	270
486	3	5 1/2	12	10.00	12.50	270
489	3	5 1/2	12 1/2	10.00	12.50	270
482	3	5 1/2	12 1/2	10.00	12.50	270
480	1 1/2	3	13	10.00	10.50	240
479	3	5	13	10.00	12.50	270
475	3	4 1/2	13	10.00	12.50	270
483	3	5 1/2	13	10.00	12.50	270

PUMP MODEL
 YES/NO N73
 YES/NO L78

AVAILABLE OPTIONS

EXHAUST
 YES/NO INCH
 YES/NO 1/2 INCH
 YES/NO 3/4 INCH
 YES/NO 1 INCH

PAINT
 YES/NO
 YES/NO
 YES/NO
 YES/NO

OTHER OPTIONS
 YES/NO
 YES/NO
 YES/NO
 YES/NO

INSTALL FOUNDATION IN POLE BARNING
 1. CALL 800-451-1616 FOR QUOTATION. SEE
 INFORMATION BOOK FOR DETAILS.

- ◆ SECTION PLANS: 10' X 12' - 10 LMC
 TAPPED HOLES FOR 10" CASTER WELV.
- ◆ SECTION PLANS: 10' X 12' - 10 LMC
 TAPPED HOLES FOR 10" CASTER
 CASTER. 10 LMC TAPPED HOLES FOR
 10" CASTER.
- ◆ FOR 3000 LBS. ASD. 80 LBS. TO REMO
 WEIGHT GIVEN.
- ★ DELIVERY IS \$8 - \$50 FOR EAST
 TAP MARKPLATE.

**FOR TAPPED OPENINGS REFER
 TO DRAWING AGN196A**

SECTION FLANGE HAS
CS-34-10 GUN TAPS
FOR 3/4" CASING ONLY

CERTIFIED FOR CONSTRUCTION PURPOSES ONLY WHEN SIGNED.

SIGNATURE _____ **DATE** _____

ADVENT GROUP

ENCLOSURE SERIAL NO. _____

CUSTOMER P.O. NO. 1 2 3 4 5 6 7 8 9

ITEM NO.

SERVICE.

1557

DRAWING IS NOT TO SCALE
DIMENSIONS IN INCHES
WEIGHTS (LBS) ARE APPROXIMATE

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

1992

RESEARCH DESIGN

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ALL

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TMC
TENCARVA MACHINERY CO

GPM Pump Selection System ver: 6.043
11/20/02

PUMP DATA SHEET

Goulds Process Pumps 60 Hz

Selection file: (untitled)

Catalog: PRCESS60.MPC v 5.1

Curve: 1590-2

Design Point: Flow: 225 US gpm
Head: 50 ft

Fluid: Water

Temperature: 60 °F

SG: 1

Viscosity: 1.122 cP

Vapor pressure: 0.2568 psi_a

Atm pressure: 14.7 psi_a

Pump: 3196_I - 1800
Speed: 1750 rpm

Size: 3x4-8G MTX

Dia: 7.5 in

Limits: Temperature: --- °F
Pressure: --- psi_g

Sphere size: --- in

Power: --- bhp

NPSHa: --- ft

Specific Speed: Ns: ---

Nss: ---

Piping:

System: ---

Suction: --- in

Discharge: --- in

Dimensions: Suction: 4 in Discharge: 3 in

Motor: 7.5 hp Speed: 1800 Frame: 213T
NEMA Standard TEFC Enclosure
sized for Max Power on Design Curve

--- Data Point ---

Flow: 225 US gpm

Head: 51.9 ft

Eff: 69%

Power: 4.27 bhp

NPSHr: 3.69 ft

-- Design Curve --

Shutoff Head: 60.1 ft

Shutoff dP: 26 psi

Min Flow: 75 US gpm

BEP: 70% eff

@ 245 US gpm

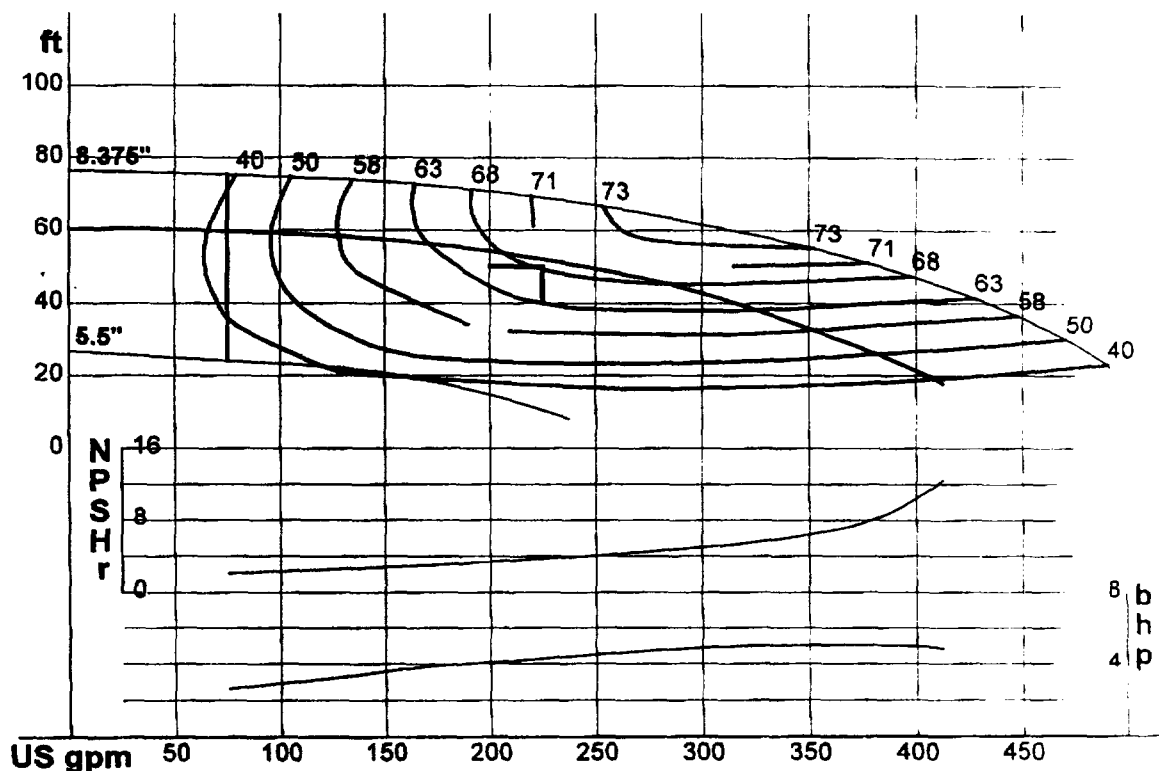
NOL Pwr: 5.01 bhp

@ 382 US gpm

-- Max Curve --

Max Pwr: 7.16 bhp

@ 471 US gpm



-- PERFORMANCE EVALUATION --

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
270	1750	47	69	4.66	4.41				
225	1750	51.9	69	4.27	3.69				
180	1750	55.5	64	3.92	3.1				
135	1750	58	59	3.35	2.64				
90	1750	59.2	48	2.79	2.24				

CENTRIFUGAL PUMP DATA SHEET


Item No: P-2		Project No.: 02691		Spec. No.:	
Description: Spray Water Pump		Project: Carbon Trt. Sys.		Location: Sauget, IL	

<p style="text-align: center;">OPERATING CONDITIONS</p> <p>CAPACITY, NORMAL <u>100</u> (GPM) RATED <u>100</u> (GPM)</p> <p>DISCHARGE PRESS <u>77.9</u> (psig)</p> <p>SUCTION PRESS MAX/RATED <u>/</u> (psig)</p> <p>DIFFERENTIAL PRESS <u>/</u> (psig)</p> <p>DIFFERENTIAL HD <u>180</u> (ft.)</p> <p>NPSH AVAIL <u>5</u> (FT) HYDRAULIC POWER <u>/</u> (whp)</p> <p>SERVICE: <input checked="" type="checkbox"/> CONTINUOUS <input type="checkbox"/> INTERMITTENT (STARTS/DAY <u><1</u>)</p> <p>LIQUID <u>Groundwater</u></p> <p>TEMP <u>70</u> (°F) MAX <u>/</u> (°F)</p> <p>S.G. <u>1.0</u> VISCOSITY @ MAX P.T. <u>1.122</u> (cp)</p> <p>VAP. PRESS @ MAX PT. <u>0.26</u> (psia) CORR/EROS BY <u>/</u></p>	<p style="text-align: center;">PERFORMANCE</p> <p>PROPOSAL CURVE NO. <u>/</u></p> <p>NO. STAGES <u>/</u> SPEED <u>/</u> RPM</p> <p>RATED EFF. <u>/</u> % RATED POWER <u>/</u> BHP</p> <p>MAX POWER RATED IMPELLER <u>/</u> BHP</p> <p>MAX HD RATED IMPELLER <u>/</u> FT</p> <p>MINIMUM CONTINUOUS FLOW: THERMAL <u>/</u> GPM</p> <p>NPSH REQ'D (H₂O) <u>/</u> (FT) STABLE <u>14.1</u> GPM</p> <p>ROTATION (FROM CPLG END): <u>/</u></p> <p>REMARKS: <u>/</u></p>
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<p style="text-align: center;">CONSTRUCTION</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>NOZZLES</th> <th>SIZE</th> <th>ANSI RATING</th> <th>FACING</th> <th>POSITION</th> </tr> <tr> <td>SUCTION</td> <td>3</td> <td>A8</td> <td>F.F.</td> <td>Horiz.</td> </tr> <tr> <td>DISCHARGE</td> <td>1.5</td> <td></td> <td>F.F.</td> <td>Vert.</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>SERVICE CONNECTIONS</th> <th>NO.</th> <th>SIZE</th> <th>TYPE</th> </tr> <tr> <td>CASING DRAIN</td> <td>1</td> <td></td> <td>NPT</td> </tr> <tr> <td>VENT</td> <td></td> <td></td> <td></td> </tr> <tr> <td>PRESS GAUGE</td> <td></td> <td></td> <td></td> </tr> <tr> <td>WARM UP</td> <td></td> <td></td> <td></td> </tr> </table>	NOZZLES	SIZE	ANSI RATING	FACING	POSITION	SUCTION	3	A8	F.F.	Horiz.	DISCHARGE	1.5		F.F.	Vert.	SERVICE CONNECTIONS	NO.	SIZE	TYPE	CASING DRAIN	1		NPT	VENT				PRESS GAUGE				WARM UP				<p style="text-align: center;">MATERIALS</p> <p>TABLE H-1 CLASS <u>/</u></p> <p>BARREL/CASE <u>D.I.</u> IMPELLER <u>316 SS</u></p> <p>CASE/IMPELLER WEAR RINGS <u>/</u></p> <p>SHAFT <u>CS</u> SLEEVE <u>316 SS</u></p> <p>DIFFUSERS <u>/</u> COUPLING HUBS <u>/</u></p> <p>COUPLING SPACER/DIAPHRAGMS <u>/</u></p> <p>BASEPLATE NO./MATL. <u>/</u> <u>Cast Iron</u></p> <p><input type="checkbox"/> VERTICAL LEVELING SCREWS</p> <p><input type="checkbox"/> HORIZONTAL POSITIONING SCREWS</p> <p>STUFFING BOX <u>/</u></p>
NOZZLES	SIZE	ANSI RATING	FACING	POSITION																																
SUCTION	3	A8	F.F.	Horiz.																																
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VENT																																				
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<p>CASE:</p> <p>TYPE: <input checked="" type="checkbox"/> END SUCTION <input type="checkbox"/> VERTICAL <input type="checkbox"/> SUMP</p> <p><input type="checkbox"/> DBL SUCTION <input type="checkbox"/> MULTI STAGE</p> <p><input type="checkbox"/> VERTICAL <input type="checkbox"/> CANTILEVER</p> <p>SPLIT: <input type="checkbox"/> AXIAL <input checked="" type="checkbox"/> RADIAL</p> <p>MOUNTING: <input checked="" type="checkbox"/> FOOT <input type="checkbox"/> IN LINE</p> <p><input type="checkbox"/> CENTERLINE <input type="checkbox"/> VERTICAL</p> <p><input type="checkbox"/> OTHER <u>/</u></p> <p>PRESS. MAWP <u>/</u> PSIG @ <u>/</u> °F</p> <p>MAWP <u>/</u> PSIG @ PUMPING TEMP.</p> <p>STUFFING BOX: <input type="checkbox"/> STD BORE <input checked="" type="checkbox"/> LARGE BORE</p> <p><input type="checkbox"/> TAPERED BORE <input type="checkbox"/> JACKETED</p> <p>IMPELLER MTG: <input type="checkbox"/> INDIVIDUALLY SECUR <input type="checkbox"/> OVERHUNG</p> <p><input type="checkbox"/> BETWEEN BEARINGS</p> <p>ROTATION (VIEWED FROM COUPLING END): <input type="checkbox"/> CW <input type="checkbox"/> CCW</p> <p>SHAFT:</p> <p>DIA. @ SLEEVE <u>/</u> (in.), COUPLING <u>/</u> (in.)</p> <p>DIA. BETWEEN BRGS. <u>/</u> (in.)</p> <p>SPAN BETWEEN BRG CENTERLINE <u>/</u> (in.)</p> <p>SPAN BETWEEN BRG & IMPELLER <u>/</u> (in.)</p> <p>COUPLINGS:</p> <p>MAKE <u>/</u> MODEL <u>/</u></p> <p>RATING (HP/100 RPM) <u>/</u></p> <p>LUBRICATION <u>/</u></p> <p>LIMITED END FLOAT REQ'D <u>/</u></p> <p>SPACER LENGTH <u>/</u> (in.) SERV. FACTOR <u>/</u></p> <p>DYNAMIC BALANCED AGMA BLANCE CLASS <input type="checkbox"/> PUMP MFR.</p> <p><input type="checkbox"/> DRIVER <input type="checkbox"/> PURCHASER <input type="checkbox"/> CPLG PER API 671</p> <p>REMARKS: <u>/</u></p>	<p style="text-align: center;">BEARINGS AND LUBRICATION</p> <p>BEARING: (TYPE/NO.)</p> <p>RADIAL <u>/</u></p> <p>THRUST <u>/</u></p> <p>LUBRICATION</p> <p><input type="checkbox"/> GREASE <input checked="" type="checkbox"/> OIL FLOOD <input type="checkbox"/> RING OIL</p> <p><input type="checkbox"/> FLINGER <input type="checkbox"/> PURGE OIL MIST <input type="checkbox"/> PURE OIL MIST</p> <p><input type="checkbox"/> CONSTANT LEVEL OILER</p> <p><input type="checkbox"/> PRESSURE <input type="checkbox"/> API-611 <input type="checkbox"/> API-614</p> <p><input type="checkbox"/> OIL VISCOSITY, GRADE <u>/</u></p> <p>OIL HEATER REQ'D <input type="checkbox"/> ELECT. <u>/</u> <input type="checkbox"/> STEAM</p>
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<p style="text-align: center;">MOTOR DRIVE</p> <p>MFR <u>/</u> HP <u>10</u></p> <p>RPM <u>3500</u> FRAME <u>/</u> SF <u>1.75</u></p> <p><input checked="" type="checkbox"/> HORIZONTAL <input type="checkbox"/> VERTICAL</p> <p>VOLTS/PHASE/HERTZ <u>480</u> <u>/</u> <u>/</u> <u>/</u></p> <p>TYPE <u>/</u> ENCLOSURE <u>1800</u></p> <p>INSULATION <u>F</u> BEARINGS <u>/</u></p> <p>LUBE <u>/</u> TEMP RISE <u>/</u></p> <p>MIN. STARTING VOLTAGE <u>/</u> FULL LOAD AMPS <u>/</u></p> <p>LOCKED ROTOR AMPS <u>/</u></p> <p>STARTING METHOD <u>/</u></p> <p>VERTICAL THRUST CAP</p> <p>UP <u>/</u> (lbs.)</p> <p>DOWN <u>/</u> (lbs.)</p> <p>REMARKS <u>NON-OVERLOADING MOTOR REQUIRED</u></p>	<p>Revision: C</p> <p>Date: 7/23/03</p> <p>Sheet 1 of 2</p> <p>Prepared By: MMH</p>
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<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">C</td> <td>Contingency Plan</td> <td></td> <td></td> <td></td> </tr> <tr> <td>B</td> <td>Pre-final Design</td> <td></td> <td></td> <td></td> </tr> <tr> <td>A</td> <td>For Review</td> <td></td> <td></td> <td></td> </tr> </table>	C	Contingency Plan				B	Pre-final Design				A	For Review				 <p>The ADVENT Group, Inc.</p>
C	Contingency Plan															
B	Pre-final Design															
A	For Review															



ISSUE	DESCRIPTION	CHK'D	APP'D	CLIENT
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CENTRIFUGAL PUMP DATA SHEET (CONT.)

Item No: <u>P-2</u>	Project No.: <u>02691</u>	Spec. No.: _____
Description: <u>Spray Water Pump</u>	Project: <u>Carbon Trt. Sys.</u>	Location: <u>Sauget, IL</u>

SEAL INFORMATION	TEST AND INSPECTION
SEAL DATA:	TEST
MFR _____	PERFORMANCE <input checked="" type="radio"/> NON WIT. <input type="radio"/> WIT.
MODEL _____	HYDROSTATIC <input checked="" type="radio"/> <input type="radio"/>
TYPE <u>Single Mechanical Seal</u>	NPSH <input type="radio"/> <input type="radio"/>
SEAL CONSTRUCTION	<input type="radio"/> COMPLETE UNIT TEST
<input checked="" type="radio"/> CARTRIDGE MOUNT	<input type="radio"/> DISMANTLE AND INSPECT AFTER TEST
<input type="radio"/> NO SLEEVE	<input type="radio"/> FINAL INSPECTION
<input type="radio"/> HOOKED SLEEVE OR NON-CARTRIDGE	<input type="radio"/> 7-DAY NOTIFICATION REQ'D
<input type="radio"/> PUMPING RING	
SLEEVE MAT'L: <u>316 SS</u>	REMARKS: <u>Provide Certified Performance Curve</u>
GLAND MAT'L: <u>316 SS</u>	_____
AVX SEAL DEVICE: <u>No</u>	_____
JACKET REQ'D: <u>No</u>	_____
OTHER REMARKS: _____	_____
_____	_____
_____	_____
_____	_____

ADDITIONAL COMMENTS:

					Revision: <u>C</u>	Date: <u>7/23/03</u>	Sheet <u>1</u> of <u>1</u>	Prepared By: <u>MMH</u>
C	Contingency Plan				 The ADVENT Group, Inc.		 Solutia Inc. St. Louis, MO	
B	Pre-Final Design							
A	For Review							
ISSUE	DESCRIPTION	CHK'D	APP'D	CLIENT				

TMC
TENCARVA MACHINERY CO
The Advent Group

GPM Pump Selection System ver 6.04
10/21/02

PUMP DATA SHEET

Goulds Process Pumps 60 Hz

Selection file: (untitled)

Catalog: PROCESS60.MPC v 5.1

Curve: 2102-2

Design Point: Flow: 100 US gpm
Head: 180 ft

Fluid: Water

Temperature: 60 °F

SG: 1

Viscosity: 1.122 cP

Vapor pressure: 0.2568 psi_aAtm pressure: 14.7 psi_a

Pump: 3196_I - 3600
Speed: 3500 rpm

Size: 1.5x3-8 STX

Dia: 6.375 in

Limits: Temperature: — °F
Pressure: — psi_g

Sphere size: — in

Power: — bhp

NPSH_a: — ft

Specific Speed: Ns: —

Nss: —

Piping:

System: —

Dimensions: Suction: 3 in

Discharge: 1.5 in

Suction: — in

Discharge: — in

Motor: 15 hp

Speed: 3600

Frame: 254T

NEMA Standard

TEFC Enclosure

sized for Max Power on Design Curve

--- Data Point ---

Flow: 100 US gpm

Head: 180 ft

Eff: 54%

Power: 8.35 bhp

NPSH_r: 4.75 ft

--- Design Curve ---

Shutoff Head: 191 ft

Shutoff dP: 82.8 psi

Min Flow: 40 US gpm

BEP: 61% eff

@ 154 US gpm

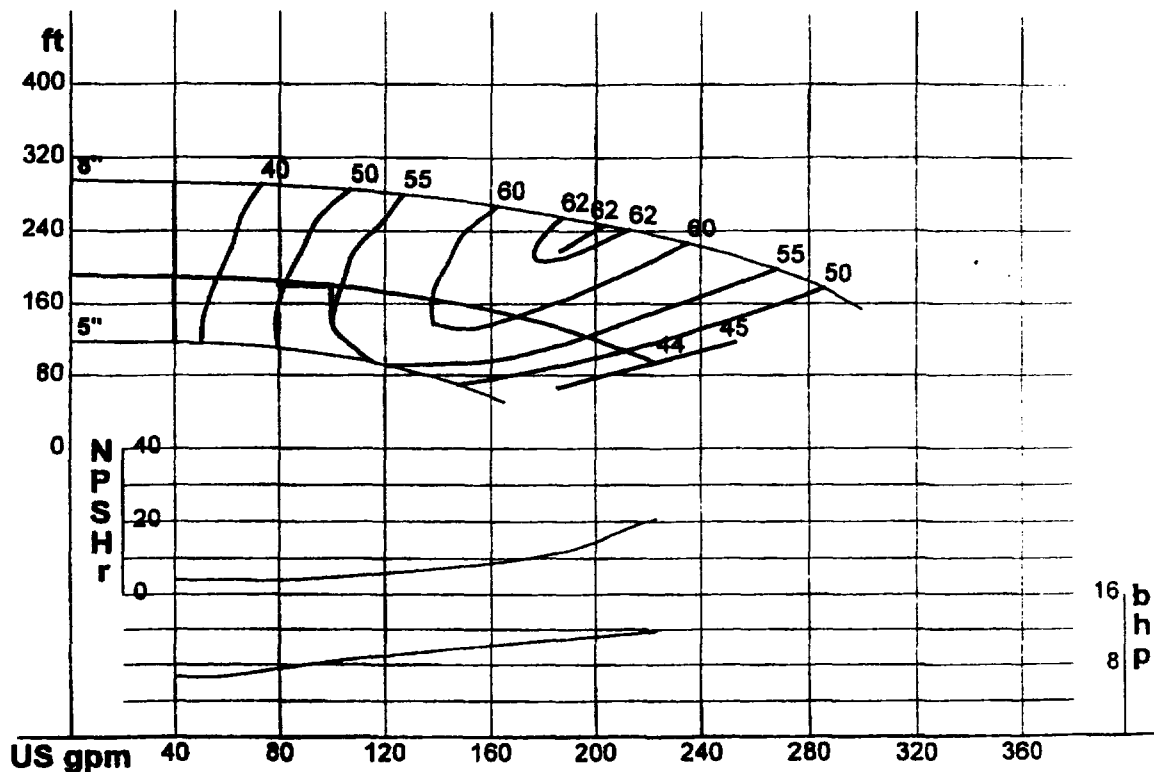
NOL Pwr: 12 bhp

@ 223 US gpm

--- Max Curve ---

Max Pwr: 27.6 bhp

@ 300 US gpm



--- PERFORMANCE EVALUATION ---

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSH _r ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
120	3500	172	57	9.01	5.85				
100	3500	180	54	8.35	4.75				
80	3500	184	49	7.57	4				
60	3500	187	41	6.8	4				
40	3500	189	29	6.69	4				

Goulds Pumps



ITT Industries

Phil Brasher

Oct 21, 2002

The Advent Group

INQ NO: 101002

Proposal No: PB210001

Item No: ITEM002

Attn: Matt Hausman

MODEL:3196 Size: 1.5x3-8 STX QTY: 1**Operating conditions****SERVICE****LIQUID***Water Temp. 60.0 deg F, Vapor Pres. 0.26 psi abs, SP.GR 1.000,**Viscosity 1.122 cp***CAPACITY Norm./Rate***100.0 / 100.0 gpm***HEAD***180.0 ft***Performance at 3500 RPM****PUBLISHED EFFY***54.0% (CDS)***RATED EFFY***51.5% with contract seal***RATED POWER***8.8 hp (incl. Mechanical seal drag 0.37). (Run out 12.2 hp)***NPSHR***4.8 (ft)***DISCH. PRESSURE***77.9 (82.7 @ Shut off) (psi g)***PERF. CURVE***2102-2 (Rotation CW viewed from coupling end)***SHUT OFF HEAD***191.0 ft***MIN FLOW***40.0 (gpm)***PRICE IN USD**

Pump Unit	Incl
Driver	Incl
Boxing	
Testing	Incl
Freight	
Accessories	
Total 1 Unit	4,349

Materials**CONSTRUCTION***Ductile iron with 316SS impeller***CASING***Ductile iron***ST.BOX COVER***Ductile iron***IMPELLER***316SS - Open (6.3750 rated (in) max=8.0000 min=5.0000)***CASING GASKET***Aramid Fiber with EPDM Rubber***IMPELLER O-RING***Teflon***SHAFT***SAE 4140***SHAFT SLEEVE***316SS***LUBRICATION***Flood oil***SEAL CHAMBER***Taper bore plus with axial ribs***BEARINGS***SKF 6207 (Inboard Bearing) SKF 5306 A/C3 (Outboard Bearing)***COUPLING***T.B. Wood's-SC 7H-***COUPLING GUARD***Carbon steel***BASEPLATE***Cast iron camber top***Sealing Method****MECHANICAL SEAL***Burgmann - Cartex - Sic/Sic EPDM 316ss - (Cartridge-Single)***Flanges***150# flat face***Liquid end features***Impeller static balance to ISO G6.3***Frame features***Ductile iron frame ring***Piping***CPI plan 7331 316SS tubing with 0.035 in wall thickness***Testing***Non witnessed assembled pump hydrostatic test**Non witnessed running performance test**Non witnessed casing hydrostatic-test***Painting***Goulds Blue water reducible coating (Strathmore)*

Proposal No: PB210001

Item No: ITEM002

MODEL: 3196

STX 1.5x3-8

Page2

Noise level Data

Maximum predicted sound pressures level pump only in Decibels (db) Re 0.0002 microbars measured 3ft horizontally and 5ft from the floor per QCP 580

Octave Band Center Freq.-Hz.									
31.5	63	125	250	500	1k	2k	4k	8k	A
62.0	63.0	66.0	72.0	67.0	66.0	65.0	62.0	62.0	72.0

Driver: Electric motor Manufacturer: Pump mfg 's Choice

FURNISHED BY Pump mfg
 RATING 15.00 hp (11.2 KW)
 PHASE/FREQ/VOLTS 3/60 Hz/230/460
 INSULATION/SF F/1.15

MOUNTED BY Pump mfg
 ENCLOSURE Severe Duty/Mill and Chemical "Epack Efficient"
 SPEED 3600 RPM
 FRAME 254T

Weights

TOTAL NET UNIT WEIGHT

473.01b

Program Version 2.3.0.0

Are you aware of PumpSmart Process Systems?

PumpSmart is a system that utilizes a standard process pump in conjunction with ITT Industries' unique and patented PumpSmart Control System and Software. The software, which resides on the controller microprocessor chip, allows the pump to monitor and react to any system condition.

PumpSmart

- Eliminates control valves, flow meters, and recirculation lines.
- Significantly reduces energy costs.
- Significantly increases MTBF.

Please contact your local Goulds Pumps representative for details and a demonstration CD-ROM. You may also contact us at www.gouldspumps.com or e-mail pumpsmart@fluids.itind.com.

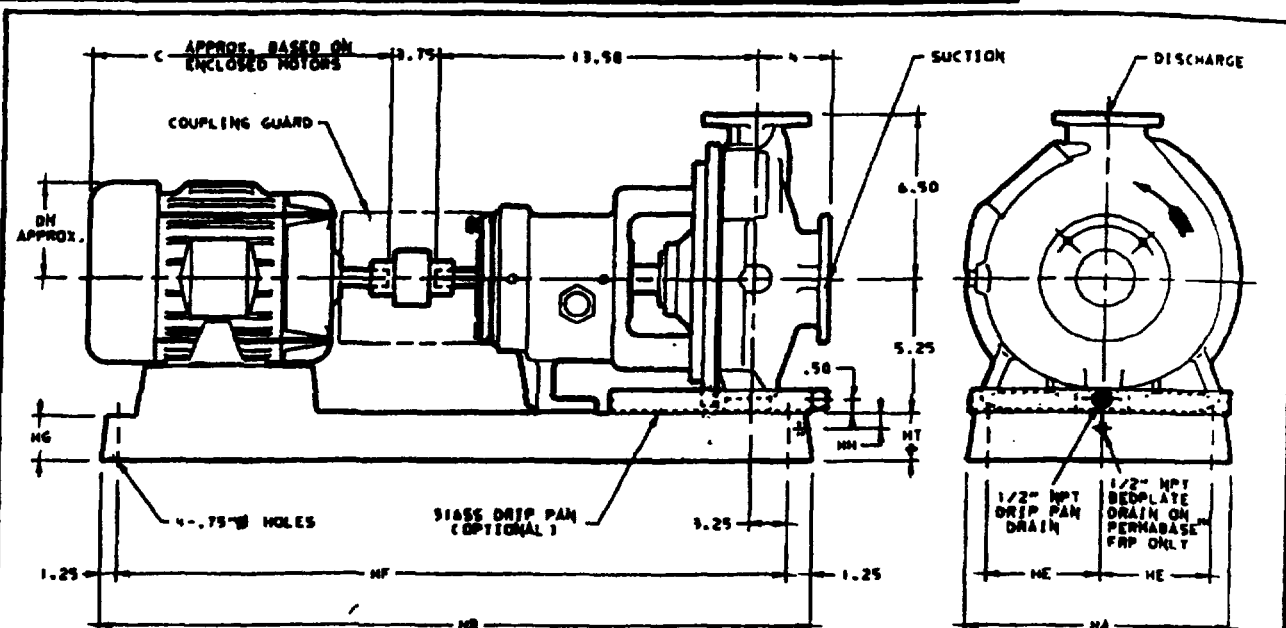


Model 3196 STX

Dimensional Prints - Pump Outline Drawing

725.1A608

October 26, 1998
(Sup. 8/14/98)



MOTOR DIMENSIONS (TEFC)					
MOTORS		C	DH	MT. INCL. CPLE.	BASE NO.
WEMA	IEC				
96	80	11	4	95	1
145T	90S	13	4	90	1
145T	90L	14	4	95	1
182T	100L	15	5	65	2
184T	112H	16	5	75	2
219T	132S	18	6	150	2
219T	132H	20	6	160	2
254T	160H	23	7	295	3
256T	160L	24	7	280	3
284T	180H	26	8	375	3
284TS	----	25	8	345	3
286T	180L	27	8	430	3
286TS	----	26	8	380	3

BASEPLATE DIMENSIONS											
NO.	NA	NB	MT		MG		ME	MF	MH	WEIGHT	
			CAST IRON	FRP	CAST IRON	FRP				CAST IRON	FRP
1	10	35	3.44	3.19	2.69	3.00	4.88	32.50	1.19	75	22
2	12	39	3.69	3.69	3.86	3.12	4.50	36.50	1.30	80	29
3	15	46	6.32	5.94	4.12	4.00	6.00	49.50	1.44	120	52

PUMP SIZE			
DISCHARGE SIZE	SUCTION SIZE	CASING CLASS	HEIGHT
1	1 1/2	6	84
1 1/2	3	6	92
2	3	6	94
3	1 1/2	8	100
3	1 1/2	3	100

AVAILABLE OPTIONS	
BASEPLATE	<input checked="" type="checkbox"/> CAST IRON <input type="checkbox"/> PERMABASE™ FRP
BIASS DRIP PAN	<input type="checkbox"/> FURNISHED <input checked="" type="checkbox"/> NOT FURNISHED
FLANGES	<input checked="" type="checkbox"/> 150# ANSI FLAT FACE <input type="checkbox"/> 150# ANSI RAISED FACE <input type="checkbox"/> 300# ANSI FLAT FACE <input type="checkbox"/> 300# ANSI RAISED FACE
CPLG. GUARD	<input type="checkbox"/> GOULDS FURNISHED BY <input type="checkbox"/> OTHERS

♦ TOLERANCE IS +0 -.50 FOR CAST IRON BASEPLATE.

■ WHEN 300# FLANGES ARE FURNISHED, DISCHARGE FLANGE WILL BE THREADED. AS FOLLOWS:

1 1/2" x 3" - 8 : 4-5/8-11 UNC-2B
1 1/2" x 3" - 8 : 4-3/4-10 UNC-2B

INSTALL FOUNDATION BOLTS IN PIPE SLEEVES, ALLOW FROM .75" TO 1.50" FOR GROUTING. SEE INSTRUCTION BOOK FOR DETAILS.

FOR TAPPED OPENINGS REFER TO DRAWING NO. A04190A.

CERTIFIED FOR CONSTRUCTION PURPOSES ONLY WHEN SIGNED.

SIGNATURE _____ DATE _____

CUSTOMER, ADVENT.

GOULDS SERIAL NO.

CUSTOMER P.O. NO.

ITEM NO.

SERVICE.

ISSUE

DRAWING IS NOT TO SCALE
DIMENSIONS IN INCHES
WEIGHTS (LBS) ARE APPROXIMATE

DRAWN DDT
08-12-92
APPROVED PTH
05-18-93

DRAWING
A04485A

REVISION
2

ISSUE
0



CENTRIFUGAL PUMP DATA SHEET

Item No: P-3		Project No.: 02691		Spec. No.:	
Description: Trailer Dewatering Pump		Project: Carbon Trl. Sys.		Location: Saugel, IL	

OPERATING CONDITIONS			PERFORMANCE		
CAPACITY, NORMAL	<u>100</u>	(GPM)	RATED	<u>100</u>	(GPM)
DISCHARGE PRESS	<u>41.1</u>	(psig)			
SUCTION PRESS MAX/RATED	<u>/</u>	(psig)			
DIFFERENTIAL PRESS	<u>/</u>	(psig)			
DIFFERENTIAL HD	<u>95</u>	(ft.)			
NPSH AVAIL	<u>3.0</u>	(FT)	HYDRAULIC POWER	<u>/</u>	(whp)
SERVICE: m	CONTINUOUS • INTERMITTENT (STARTS/DAY)		<u><1</u>		
LIQUID	<u>Groundwater</u>				
TEMP	<u>70</u>	(°F)	MAX	<u>/</u>	(°F)
S.G.	<u>1.0</u>	VISCOSITY @ MAX P.T.	<u>1.122</u>		(cp)
VAP. PRESS @ MAX PT. @ 26	(psia)		CORR/EROS BY	<u>/</u>	

CONSTRUCTION				
NOZZLES	SIZE	ANSI RATING	FACING	POSITION
SUCTION	<u>3</u>	<u>A8</u>	<u>F.F.</u>	<u>Horiz.</u>
DISCHARGE	<u>2</u>	<u>/</u>	<u>F.F.</u>	<u>Vert.</u>

SERVICE CONNECTIONS	NO.	SIZE	TYPE
CASING DRAIN	<u>1</u>	<u>/</u>	<u>1-1/2</u>
VENT	<u>/</u>	<u>/</u>	<u>/</u>
PRESS GAUGE	<u>/</u>	<u>/</u>	<u>/</u>
WARM UP	<u>/</u>	<u>/</u>	<u>/</u>

CASE:

TYPE: • END SUCTION ○ VERTICAL ○ SUMP
 ○ DBL SUCTION ○ MULTI STAGE
 ○ VERTICAL ○ CANTILEVER

SPLIT: ○ AXIAL • RADIAL

MOUNTING: • FOOT ○ IN LINE
 ○ CENTERLINE ○ VERTICAL
 ○ OTHER

PRESS. MAWP _____ PSIG @ _____ °F
 MAWP _____ PSIG @ PUMPING TEMP.

STUFFING BOX: ○ STD BORE • LARGE BORE
 ○ TAPERED BORE ○ JACKETED

IMPELLER MTG: ○ INDIVIDUALLY SECUR ○ OVERHUNG
 ○ BETWEEN BEARINGS

ROTATION (VIEWED FROM COUPLING END): ○ CW ○ CCW

SHAFT:

DIA. @ SLEEVE _____ (in.), COUPLING _____ (in.)
 DIA. BETWEEN BRGS. _____ (in.)
 SPAN BETWEEN BRG CENTERLINE _____ (in.)
 SPAN BETWEEN BRG & IMPELLER _____ (in.)

COUPLINGS:

MAKE _____ MODEL _____
 RATING (HP/100 RPM) _____
 LUBRICATION _____
 LIMITED END FLOAT REQ'D _____
 SPACER LENGTH _____ (in.) SERV. FACTOR _____
 DYNAMIC BALANCED AGMA BLANCE CLASS: ○ PUMP MFR.
 ○ DRIVER ○ PURCHASER ○ CPLG PER API 671

REMARKS: _____

PROPOSAL CURVE NO. _____

NO. STAGES _____ SPEED _____ RPM

RATED EFF. _____ % RATED POWER _____ BHP

MAX POWER RATED IMPELLER _____ BHP

MAX HD RATED IMPELLER _____ FT

MINIMUM CONTINUOUS FLOW: THERMAL _____ GPM

NPSH REQ'D (H₂O) _____ (FT) STABLE 14.1 GPM

ROTATION (FROM CPLG END): _____

REMARKS: _____

MATERIALS

TABLE H-1 CLASS _____

BARREL/CASE D.1 IMPELLER 316 SS

CASE/IMPELLER WEAR RINGS _____

SHAFT C3 SLEEVE 316 SS

DIFFUSERS _____ COUPLING HUBS _____

COUPLING SPACER/DIAPHRAGMS _____

BASEPLATE NO./MATL. / Cast Iron

○ VERTICAL LEVELING SCREWS

○ HORIZONTAL POSITIONING SCREWS

STUFFING BOX _____

BEARINGS AND LUBRICATION

BEARING: (TYPE/NO.) _____

RADIAL _____

THRUST _____

LUBRICATION

○ GREASE • OIL FLOOD ○ RING OIL

○ FLINGER ○ PURGE OIL MIST ○ PURE OIL MIST

○ CONSTANT LEVEL OILER

○ PRESSURE ○ API-611 ○ API-614

○ OIL VISCOSITY, GRADE _____

OIL HEATER REQ'D ○ ELECT. _____ ○ STEAM

MOTOR DRIVE

MFR _____ HP 10

RPM 1750 FRAME _____ SF 1.15

• HORIZONTAL ○ VERTICAL

VOLTS/PHASE/HERTZ 460 / 3 / 60

TYPE _____ ENCLOSURE TEFC

INSULATION F BEARINGS _____

LUBE _____ TEMP RISE _____

MIN. STARTING VOLTAGE _____ FULL LOAD AMPS _____

LOCKED ROTOR AMPS _____

STARTING METHOD _____

VERTICAL THRUST CAP


UP _____ (lbs.)

DOWN _____ (lbs.)


REMARKS NON-OVERLOADING MOTOR REQUIRED

Revision: C		Date: 7/23/03	Sheet: 1 of 1	Prepared By: MMH
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C	Contingency Plan				
B	Pre-final Design				
A	For Review				
ISSUE	DESCRIPTION	CHKD	APPD	CLIENT	



The ADVENT Group, Inc.



Solutia Inc.
St. Louis, MO



CENTRIFUGAL PUMP DATA SHEET (CONT.)

Item No: <u>P-3</u>	Project No.: <u>02691</u>	Spec. No.:
Description: <u>Trailer Dewatering Pump</u>	Project: <u>Carbon Trt. Sys.</u>	Location: <u>Sauget, IL</u>

SEAL INFORMATION	TEST AND INSPECTION
SEAL DATA:	TEST
MFR _____	PERFORMANCE ● ○
MODEL _____	HYDROSTATIC ● ○
TYPE <u>Single Mechanical</u>	NPSH ○ ○
SEAL CONSTRUCTION	○ COMPLETE UNIT TEST
● CARTRIDGE MOUNT	○ DISMANTLE AND INSPECT AFTER TEST
○ NO SLEEVE	○ FINAL INSPECTION
○ HOOKED SLEEVE OR NON-CARTRIDGE	○ 7-DAY NOTIFICATION REQ'D
○ PUMPING RING	
SLEEVE MAT'L: <u>316 SS</u>	REMARKS: <u>Provide Certified Performance Curve</u>
GLAND MAT'L: <u>316 SS</u>	_____
AVX SEAL DEVICE: <u>No</u>	_____
JACKET REQ'D: <u>No</u>	_____
OTHER REMARKS: _____	_____
_____	_____
_____	_____
_____	_____

ADDITIONAL COMMENTS:

				Revision: <u>C</u>	Date: <u>7/2/303</u>	Sheet <u>1</u> of <u>1</u>	Prepared By: <u>MMH</u>
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C	Contingency Plan					 The ADVENT Group, Inc.	 Solutia Inc. St. Louis, MO
B	Pre-Final Design						
A	For Review						
ISSUE	DESCRIPTION	CHK'D	APP'D	CLIENT			

Goulds Pumps



Phil Brasher

Proposal No: PB211002

Item No: ITEM003

Nov 20, 2002

MODEL:3196 Size: 2x3-10 MTX QTY: 1

Operating conditionsSERVICE
LIQUID*Water Temp. 60.0 deg F, Vapor Pres. 0.26 psi abs, SP.GR 1.000,
Viscosity 1.122 cp*CAPACITY Norm./Rate
HEAD*100.0 / 100.0 gpm
95.0 ft***Performance at 1750 RPM**

PUBLISHED EFFY

51.0% (CDS)

RATED EFFY

51.0%

RATED POWER

4.7 hp (Run out 8.4 hp)

NPSHR

3.0 (ft)

DISCH. PRESSURE

41.1 (43.2 @ Shut off) (psi g)

PERF. CURVE

5025-2 (Rotation CW viewed from coupling end)

SHUT OFF HEAD

99.9 ft

MIN FLOW

*19.0 (gpm)***PRICE IN USD**

Pump Unit	incl
Driver	incl
Boxing	
Testing	
Freight	
Accessories	
Total 1 Unit	5,182

Materials

CONSTRUCTION

Ductile iron with 316SS impeller

CASING

Ductile iron

ST. BOX COVER

Ductile iron

IMPELLER

316SS - Open (9.5000 rated (in) max=10.0000 min=6.0000)

CASING GASKET

Aramid Fiber with EPDM Rubber

IMPELLER O-RING

Teflon

SHAFT

SAE 4140

SHAFT SLEEVE

316SS

LUBRICATION

Flood oil

SEAL CHAMBER

Big bore

BEARINGS

SKF 6309 (Inboard Bearing) SKF 5309 A/C3 (Outboard Bearing)

COUPLING

T.B. Wood's-SC 6-

COUPLING GUARD

Carbon steel

BASEPLATE

*Cast iron camber top**Current motor frame is 215T. Baseplate is sized to accommodate 254T future motor size***Sealing Method**

MECHANICAL SEAL

*Burgmann - Cartex - Silicon Carbide vs Silicon Carbide EPDM 316SS - (Cartridge-Single)***Flanges***150# flat face***Liquid end features***Impeller static balance to ISO G6.3***Frame features***Ductile iron frame adapter***Piping***CPI plan 7301 armored Teflon hose A-20 Fittings***Baseplate Features***Engineering charge for future frame**2 Frame baseplate drilling***Painting***Goulds Blue water reducible coating (Strathmore)*

Proposal No: PB211002

Item No: ITEM003

MODEL: 3196

MTX 2x3-10

Page2

Noise level Data

Maximum predicted sound pressures level pump only in Decibels (db) Re 0.0002 microbars measured 3ft horizontally and 5ft from the floor per QCP 580

				Octave Band Center Freq.-Hz.					
31.5	63	125	250	500	1k	2k	4k	8k	A
65.0	66.0	65.0	67.0	67.0	69.0	68.0	68.0	67.0	75.0

Driver: Electric motor Manufacturer: Pump mfg 's Choice

FURNISHED BY *Pump mfg*
RATING *10.00 hp (7.5 KW)*
PHASE/FREQ/VOLTS *3/60 Hz/230/460*
INSULATION/SF *F/1.15*

MOUNTED BY *Pump mfg*
ENCLOSURE *Severe Duty/Mill and Chemical Premium Efficiency*
SPEED *1800 RPM*
FRAME *215T*

Weights

TOTAL NET UNIT WEIGHT

573.01lb

Program Version 2.3.0.0



725.1A628

October 26, 1998
(Sup. 8/14/98)



TMC
TENCARVA MACHINERY CO

GPM Pump Selection System ver: 6.043
11/20/02

PUMP DATA SHEET

Goulds Process Pumps 60 Hz

Selection file: ADV1119.UFS

Catalog: PROCESS60.MPC v 5.1

Curve: 5025-1

Design Point: Flow: 100 US gpm
Head: 95 ft

Fluid: Water

Temperature: 60 °F

SG: 1

Viscosity: 1.122 cP

Vapor pressure: 0.2568 psi_a

Atm pressure: 14.7 psi_a

Pump: 3196_I - 1800
Speed: 1750 rpm

Size: 2x3-10 MTX

Dia: 9.5 in

Limits: Temperature: --- °F
Pressure: --- psi_g

Sphere size: --- in
Power: --- bhp

NPSHa: --- ft

Specific Speed: Ns: ---

Nss: ---

Piping:

System: ---

Suction: --- in

Discharge: --- in

Dimensions: Suction: 3 in

Discharge: 2 in

Motor: 10 hp

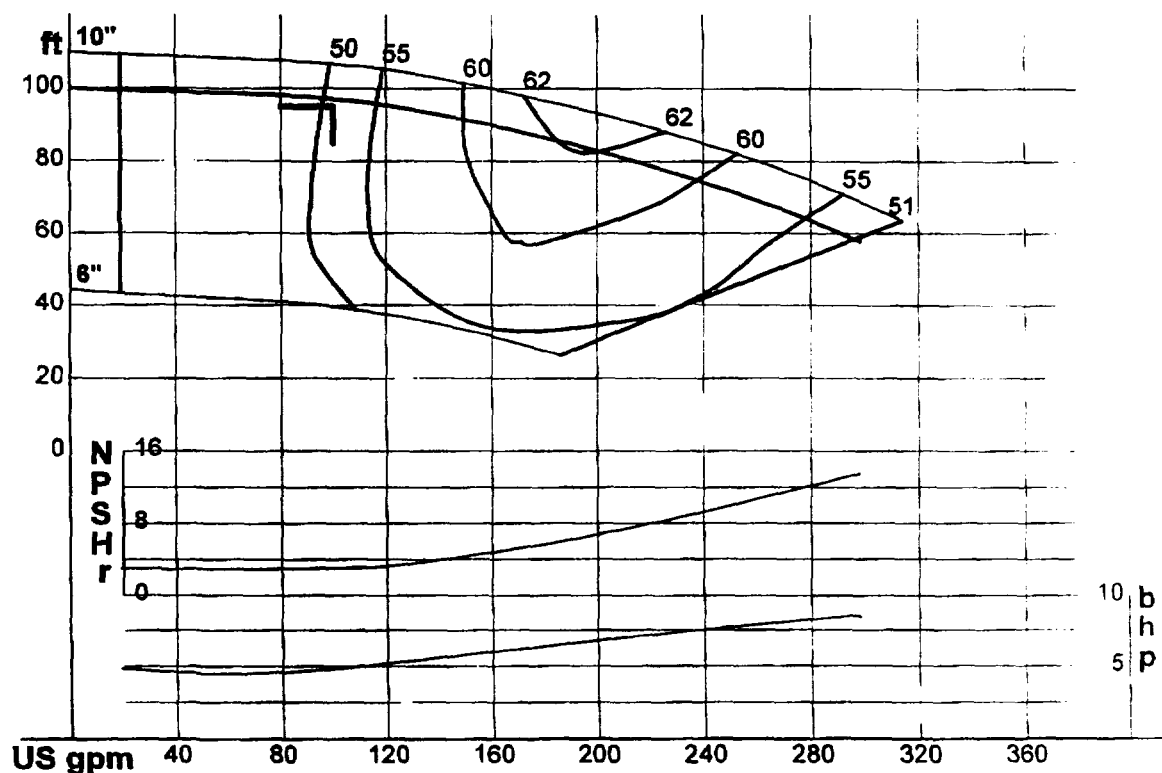
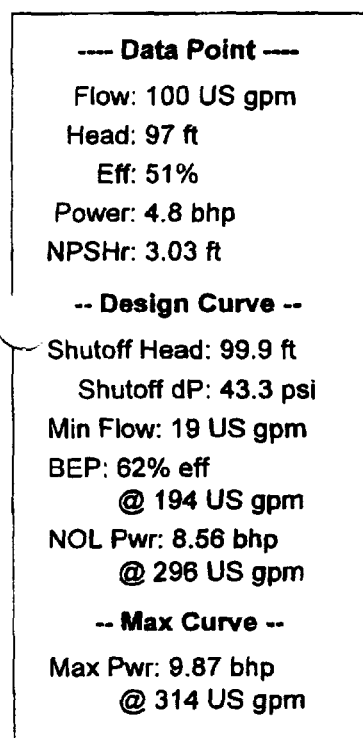
Speed: 1800

Frame: 215T

NEMA Standard

TEFC Enclosure

sized for Max Power on Design Curve



— PERFORMANCE EVALUATION —

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
120	1750	95.3	56	5.19	3.27				
100	1750	97	51	4.8	3.03				
80	1750	97.7	42	4.76	3				
60	1750	98.3	31	4.78	3				
40	1750	98.8	21	4.81	3				

TANK DATA SHEET

Item No.: T-1	Project No.: 02691	Spec. No.:
Description: Backflush Supply Tank	Project: Carbon Treat. Sys.	Location: Sauget, IL

See Drawing Number SS-1

1	Service: Treated Groundwater										
2	Shell Dia. (I.D.): 14'			Height: 12'							
3	Number Req'd: 1										
4	PRESSURE			TEMPERATURE		NOZZLES	Mark No.	Size (in.)	Qty	Facing	Rating
5	Operating	Atm.	70		Drain	A	6"	1	F.F.	150#	
6	Design	Atm.	Ambient		Backflush	B	8"	1	F.F.	150#	
7		MATERIAL	CORR. ALLOW.		Trailer	C	4"	1	F.F.	150#	
8	Shell:	CS	None		Spare	D	4"	1	F.F.	150#	
9	Roof:	N/A	N/A		Overflow	E	8"	1	F.F.	150#	
10	Liner:	N/A			Fill	F	8"	2	FL-FL	150#	
11	Type of Roof:	N/A		Uniform Load:	N/A						
12	Code:	API-650 Appendix J									
13	Emergency Vacuum Design:	N/A									
14	Liquid Ht	10.5 ft	Sp. Gr.	1.0	at	70	°F				
15	Insulation:	N	Type:								
16	Stress Relieve for Process Reasons:										
17	Min. design metal temperature:	5 F									
18	Steam out conditions:	psig @		°F							
19	Design Wind Speed:	70		mph							
20	Seismic Zone:	2A									
21	MECHANICAL (MATERIALS)										
22											
23											
24											
25											
26											
27	Applicable code:										
28	Construction:			Inspection:							
29	Stress Relieve:			Radiograph:							
30	Testing:										
31											

Remarks:

Tank Internal Coating/Liner:
Surface prep. According to SSPC-SP5
2 coats epoxy-polyamide 8-10 mil total DFT
(Tnemec 66 or equivalent)

Tank External Coating:
Surf. prep acc. to SSPC-SP6
Prime coat alkyd phenolic primer 2-3.5 mDFT
(Tnemec Series 37 or equivalent)
Top coat alkyd enamel, 2 coats at 1.5-3.5 mDFT per coat
Tnemec Series 2H or equivalent

Other Remarks:

PREPARED ON BEHALF OF
Solutia, Inc.

Revision
C

Date
7/23/03

Prepared By
ATL

C

Contingency Plan

B

Pre-Final Design

A

For Review

ISSUE

DESCRIPTION

APP'D

CLIENT



The ADVENT Group, Inc.

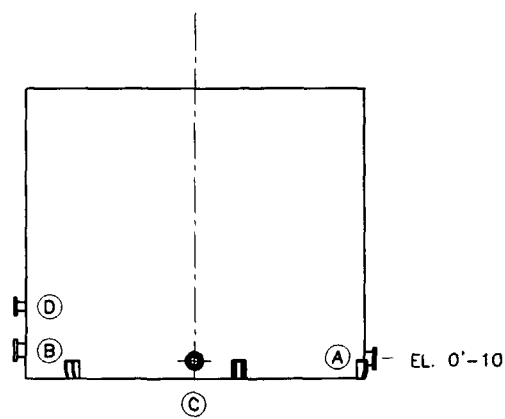
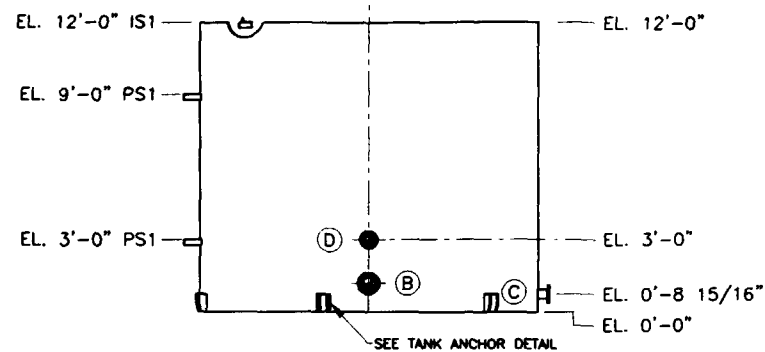
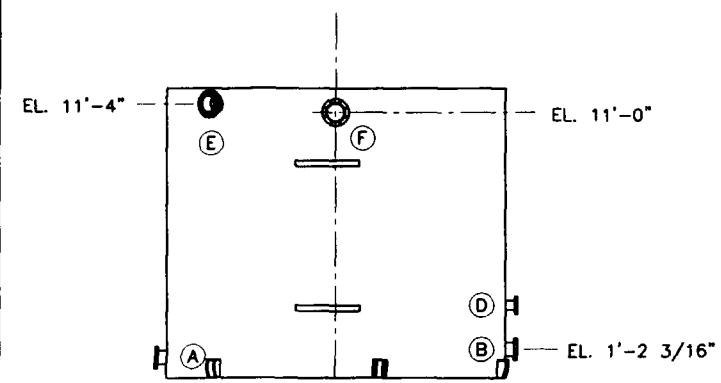
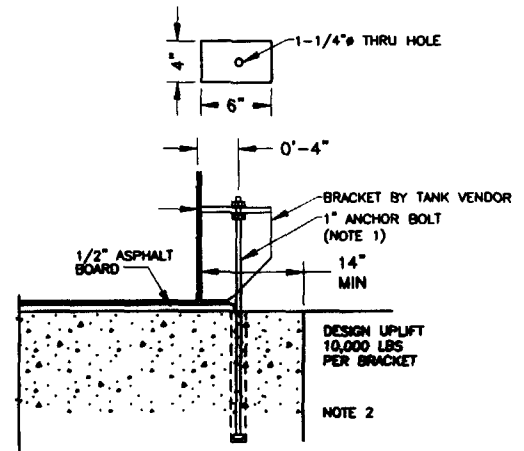
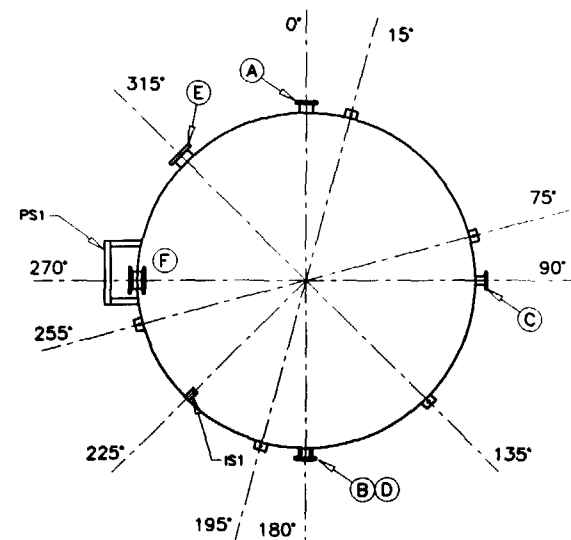
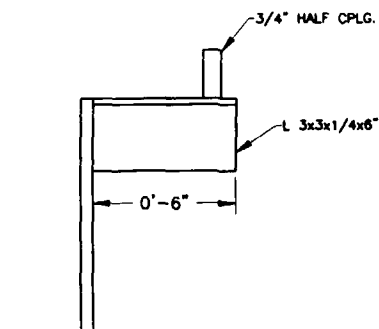
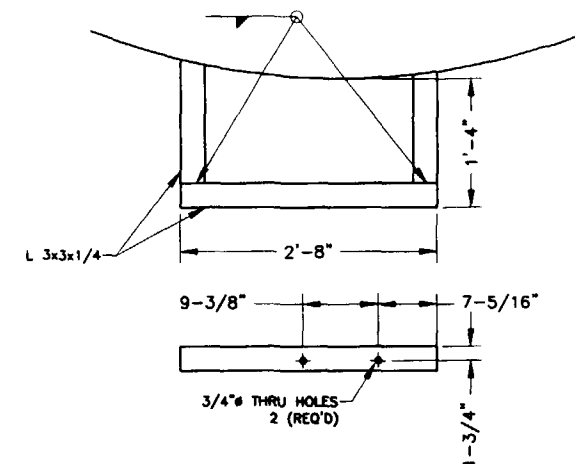
SOLUTIA

Solutia Inc.
St. Louis, MO


NOTES:

- 1" ANCHOR BOLT TO BE HAS STANDARD ASTMA36 STEEL ROD SECURED WITH HY150 ADHESIVE PER HILTI. MINIMUM EMBEDMENT OF BOLT IS 8 1/4" BELOW TOP OF CONCRETE.
- SITE WORK, SLAB, AND FOUNDATIONS TO BE DESIGNED BY OTHERS.

NOZZ.	QTY.	TYPE/ DESCRIPTION	ORIENT.	SERVICE		
A	1	8" 150# FLG	-	DRAIN		
B	1	8" 150# FLG	-	BACKFLUSH		
C	1	4" 150# FLG	-	TRAILER		
D	1	4" 150# FLG	-	SPARE		
E	1	8" 150# FLG	-	OVERFLOW		
F	2	8" 150# FLG/FLG	-	FILL		
G						
OVERALL DIMENSIONS (FT-INCH)						
HEIGHT	DIA	C	D	E	F	G
12'-0"	14'-0"					
DESIGN PRESS. PSIG		AMB	OP. PRESS. PSIG		ATM.	
DESIGN TEMP. DEG F		AMB	OP. TEMP. DEG F		70	
LIQUID WATER PH.		7.0	SP. GRAVITY		1.0	
DRY WT. LBS.		-	OP. WT. LBS.		-	
TANK VOL. GAL.		12,000				
DESIGN CODE:		API650, APPENDIX J				



T-1
BACKFLUSH SUPPLY TANK

D	CONTINGENCY PLAN	7/23/03	CSR	RLR
C	PRE-FINAL DESIGN	11/19/02	CSR	RLR
REV	DESCRIPTION	DATE	APPR BY	MADE BY
REVISIONS				
				
THE ADVENT GROUP, INC.				
Nashville, Tennessee				
BACKFLUSH SUPPLY TANK PLAN AND ELEVATION				
SOLUTIA KRUMMRICH SAUGET, IL				
BY		DATE		
DRAWN	RLR	11/14/02	APPR.	CSR
CHKD.	TL	11/14/02		
SCALE: 1/4"=1'-0"		SHEET 1 OF 1		SIZE D
FILE LOCATION: L:\DATA\02691\CAD\PIPING\PP-01_03-SS-01.DWG				
CONTRACT NO.		DRAWING NO.		REV.
02691		SS-01		D

AIR COMPRESSOR



Item No:	C-1	Project No.:	02691	Spec. No.:	
Description:	Carbon Transfer Air	Project:	Carbon Trt. Sys.	Location:	Sauget, IL

GENERAL

The air compressor shall be of a single stage, 40 CFM minimum, 100 psig, oil injected, air cooled, screw type. All components will be provide as a package unit with a sound enclosure and outside weather protection. The package will include an oil injected air cooled, screw type, compressor, drive motor, oil lubricating system, air system, and minimum 120 gallon ASME coded air receiver. All electronic regulating controls shall be provided.

COMPONENTS

Compressor	The compressor element shall be a rotary screw design consisting of asymmetrical rotor profile for minimal internal leakage and maximum compressor efficiency. Heavy duty bearings capable of L-10 bearing life in excess of 90,000 hrs shall be used.
Drive Motor	Shall be TEFC NEMA or IEC T frame, squirrel cage, induction type with Class F insulation. Motor to be 3 ph, 60 Hertz, 460 Volt. Motor construction shall be rugged cast frame, cast rotor, non-hygroscopic insulation, phase corrosion resistant wire, premium efficiency. Motor service factor shall be 1.15.
Oil System / Aftercooler	Lubrication shall be accomplished by inherent pressure differentials and without the use of an external mechanical oil pump. A heavy duty, full flow 10 micron oil filter and oil aftercooler shall be provided with an OSHA approved fan guard. The aftercooler, moisture separator and automatic condensate trap are to be piped and mounted within the compressor package.
Air System	The air system shall consist of a dry-type air intake filter rated at 3 microns, pneumatically operated air intake valve /
Controls	<p>A solid state electronic control system shall be provided including:</p> <ul style="list-style-type: none"> • Constant run control (load / no load) • Automatic start / stop control • Drive motor overload indicator with shutdown • Dual / Independent high temperature indicator with shutdown • Air filter change indicator • Digital readouts for compressor discharge air pressure and air temperature, reservoir discharge pressure • Stop / reset indicator • Mounted and wired starter • Moisture sensor status • Oil separator change indicator

PREPARED ON BEHALF OF Solutia, Inc.				Rev.: C	Date: 7/23/03	Prepared by: ATL
C	Contingency Plan			 The ADVENT Group, Inc.		 Solutia Inc. St. Louis, MO
B	Pre-Final Design					
A	For Review					
ISSUE	DESCRIPTION	APP'D	CLIENT			

GA5-11C SERIES

Oil Injected
Rotary Screw Compressors
7 1/2 thru 15 Horsepower

MODEL		GA5				GA7				GA11C			
		100	125	150	175	100	125	150	175	100	125	150	175
General													
Horsepower	HP	7.5				10				15			
Capacity-FAD ⁽¹⁾	CFM	29	25	21	18	41	36	31	27	57	52	47	42
Operating Pressure ⁽²⁾	PSIG	100	125	150	175	100	125	150	175	100	125	150	175
Min Operating Pressure ⁽²⁾	PSIG	58				58				58			
Max Package Pressure ⁽²⁾													
- Standard Pack, Pack	PSIG	107	132	157	181	107	132	157	181	107	132	157	181
Drive System		V-Belt				V-Belt				V-Belt			
Power Requirements													
Compressor	BHP	7.9	8.9	8.3	8.0	11.3	11.8	11.5	11.1	16.9	17.6	17.4	17.6
Compressor Fan	BHP	0.1				0.1				0.1			
Pack Unit (Total)	BHP	8.0	9.0	8.4	8.1	11.4	11.9	11.6	11.2	17.0	17.7	17.5	17.7
Compressor @ No Load	BHP	4.6	4.0	3.9	3.6	6.0	5.5	5.4	4.8	8.0	7.6	7.1	6.8
Cooling													
Cooling Medium		Air				Air				Air			
Maximum Ambient Temp	°F	104				104				104			
Minimum Ambient Temp ⁽³⁾	°F	32				32				32			
Cooling Air Flow													
- Standard Pack, Pack	CFM	954				954				1,127			
- Full Feature	CFM	1,304				1,307				1,624			
Package BTU Rejection													
- Standard Pack, Pack	BTU/hr	22,145				30,290				45,301			
- Full Feature	BTU/hr	23,250				31,665				47,185			
Allowable Pressure Drop													
in Duct Work	inches of water	.12				.12				.12			
Aftercooler Approach													
- Standard Pack, Pack	°F	13				17				21			
Oil Capacity	Gal	1.23				1.23				1.23			
Noise Level⁽⁴⁾													
- Standard Pack, Pack, FF	dB(A)	66				67				68			

⁽¹⁾ FAD (Free Air Delivery) measured according to CAGI-PNEUROP PN2CPT2/ISO1217, Ed. 3, Annex C-1996

⁽²⁾ Full Feature units, dryer module air pressure drops must be included

⁽³⁾ Freeze Protection will be required in ambients below 32°F (reference price page)

⁽⁴⁾ Noise level measured according to CAGI-PNEUROP PN8NTC2.2 test code

GA5-11C SERIES

Oil Injected
Rotary Screw Compressors
7 1/2 thru 15 Horsepower

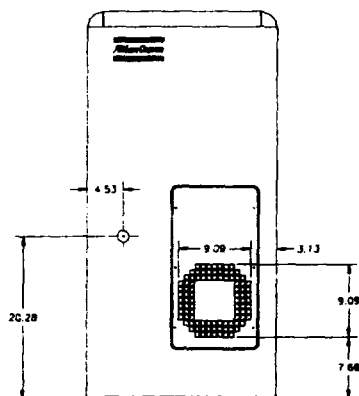
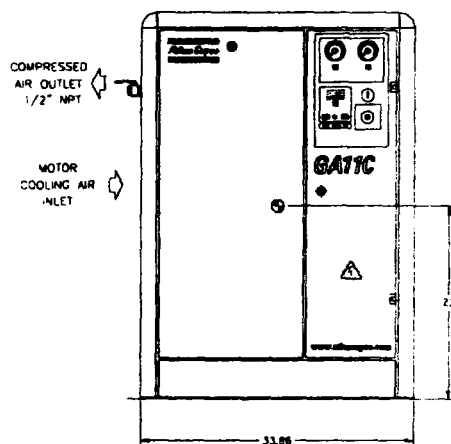
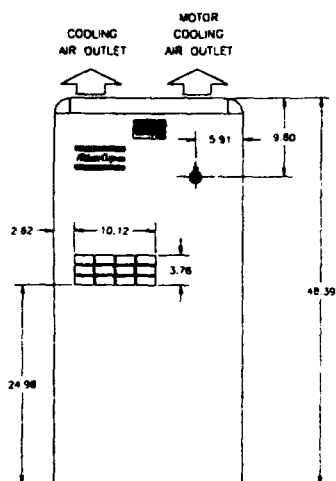
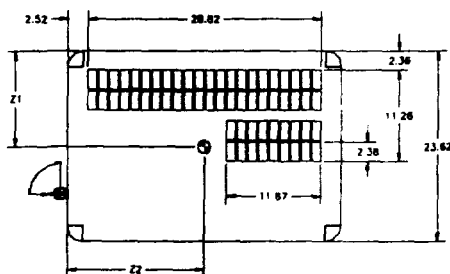
MODEL			GA5				GA7				GA11C			
			100	25	150	175	100	125	150	175	100	125	150	175
Dimensions														
Standard Pack, Pack (LxWxH) ⁽⁵⁾	in		34 x 24 x 49				34 x 24 x 49				34 x 24 x 49			
Full Feature (LxWxH) ⁽⁵⁾	in		34 x 24 x 49				34 x 24 x 49				34 x 24 x 49			
Tank Mtd (LxWxH)	in		68 x 37 x 73				68 x 37 x 73				68 x 37 x 73			
Discharge Valve Connection														
Standard Pack, Pack, FF	in NPT		½				½				½			
Tank Mtd	in NPT		¾				¾				¾			
Condensate Drain Connections														
- Manual outside/inside diameter	in		.24 / .16				.24 / .16				.24 / .16			
- Automatic outside/inside dia.	in		.32 / .22				.32 / .22				.32 / .22			
Weights (approx.)														
Base Mounted														
Standard Pack/Pack/FF														
- Net	lbs		465 / 467 / 522				485 / 487 / 542				514 / 516 / 582			
- Shipping	lbs		587 / 589 / 644				606 / 608 / 664				635 / 637 / 703			
Tank Mounted														
Standard Pack/Pack/FF														
- Net	lbs		815 / 817 / 872				835 / 837 / 892				864 / 866 / 932			
- Shipping	lbs		972 / 974 / 1029				991 / 993 / 1049				1020 / 1022 / 1088			
Refrigerated Dryer														
Full Feature Only														
Dryer module	Model		ID 19				ID 19				ID 26			
Compressor rating (nominal)	HP		.67				.67				1.1			
Pressure Dewpoint ⁽⁶⁾	°F		35-39				35-39				35-39			
Pressure Drop at nominal capacity	PSIG		1.0	.58	.44	.29	1.89	1.16	.73	.44	3.77	2.61	1.74	1.31
Cooling Air Flow	CFM		353				353				353			
Outlet Temperature above ambient	°F		6				8				11			
Refrigerant Type			R134a				R134a				R134a			
Refrigerant Charge	lbs		.88				.88				.88			
Input Power														
- Compressor	KW		0.5				0.5				0.8			
- Fan Motor	KW		0.1				0.1				0.1			
Recommended Filter ⁽⁷⁾														
1.0 micron	DDp		17	17	17	17	32	32	17	17	32	32	32	32
1.0 micron/0.1 PPM	DD		17	17	17	17	32	32	17	17	32	32	32	32
0.01micron/0.01PPM	PD		17	17	17	17	32	32	17	17	32	32	32	32
0.003 PPM	QD		17	17	17	17	32	32	17	17	32	32	32	32

⁽⁵⁾ Discharge valve adds approximately 5 inches to installed length

⁽⁶⁾ Dewpoint at standard Atlas Copco ref. conditions

⁽⁷⁾ At standard filter inlet conditions (Ref. Filter Price Book Section)

	WEIGHT (lbs.)	Z1	Z2	Z3
GA 5	467.46	12.0	18.11	25
GA 7	487.31	11.81	17.91	24.41
GA 11C	516	11.61	17.71	23.82



☐ INFORMATION ONLY
☐ CERTIFIED
☐ APPROVAL REQUIRED
 (CUSTOMER STAMP REQUIRED)
 DATE: _____
 NAME: _____

DO NOT SCALE DRAWING
 THE INFORMATION ON THIS DRAWING IS THE PROPERTY OF ATLAS COPCO COMPRESSORS INC.
 ATLAS COPCO COMPRESSORS INC.
 HOLLAND, MASSACHUSETTS
 DR. BY: J.E. 1.6 (DPP)
 GENERAL ARRANGEMENT
 STANDARD PACE
 GAS/11C
 SEE NOTE 10
 SHEET 1/1
 1310 9077 66 01

1	EQUIPMENT TYPE - 11C GAS TO B. HINDS INCH	DATE: 01/04/03	BY: P.S.O.
REV	MODIFIED FROM	DATE	BY

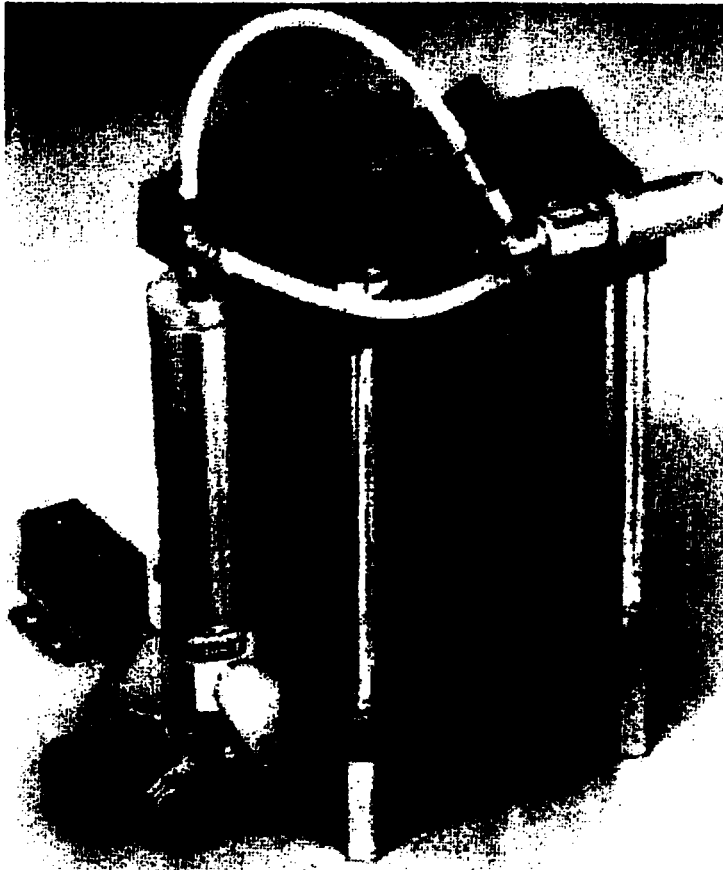
AIR AND LIQUID PURIFICATION SYSTEMS

MBCI

MILLER/BOWERS COMPANY, INC.

Drain Guard

Compressed Air Condensate Drain Trap



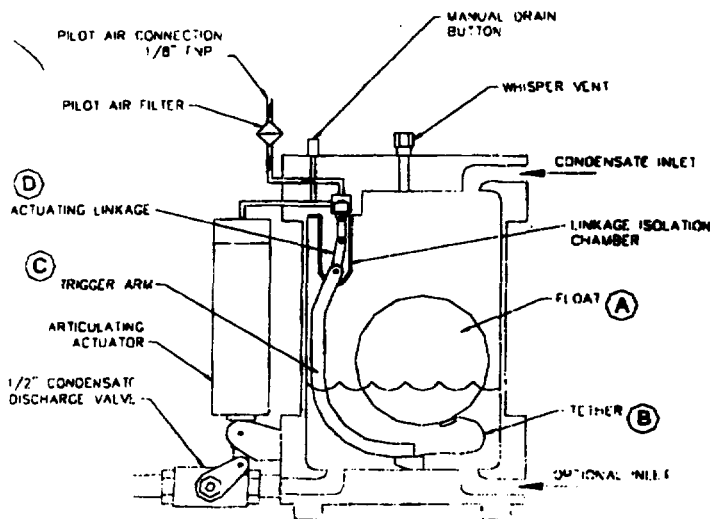
Drain Guard Model AD9800/SPC Patents Pending
Height 10-1/4" Width 9-5/8" Depth 7-1/2"
Maximum Working Pressure: 200 PSIG

Drain the Condensate, Keep the Air...
Do it with *Drain Guard*.

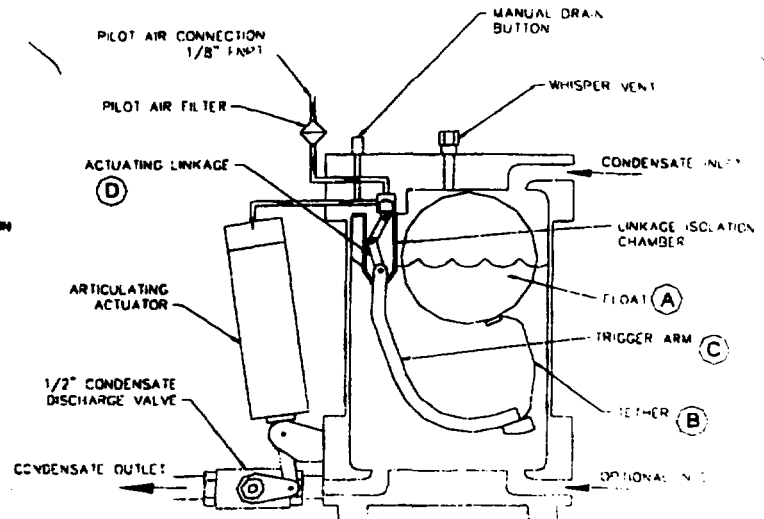
For Sales Information:

Miller / Bowers Co., Inc.
1680 South Livernois
Rochester Hills, MI 48307
Phone: (248) 656-3605 Fax: (248) 656-3618
email: Sales@dlbmhci.com

- Efficient, Airless Discharge
- Automatic, Reliable Operation
- Maximum Return on Investment
- No Electricity Required;
Intrinsically Safe
- Sealed Actuation Mechanism
- No Magnets to Attract Metallic
Particles
- Non-Clogging; 1/2" NPT
Inlet / Outlet Ports
- 1/8" Pilot Compressed Air
Connection
- SPC Cycle Counter to Measure
the Frequency of Drain
Operation
- Light Weight (13 Lbs.); Easy to
Install, Hang, Mount, etc.
- Trundle-Mounted Actuator
Increases Ball Valve Life
- Engineered for Most Chemically
Hostile Environments
- Three Year Limited Warranty



CLOSED POSITION



OPEN POSITION

Operating Cycle:

As condensate accumulates in the reservoir, float (A) rises, until tether (B) pulls on trigger arm (C).

At the 52 ounce level, actuating linkage (D) moves laterally, opening the pilot air, which powers the actuator, discharging the liquid.

Float drops as the liquid exits, lever assembly returns to vertically aligned position, the pilot air is shut off, causing the discharge valve to close.

Trouble Free Solution

- Drain Guard Discharges Liquid Only, Never Compressed Air.
- Demand Activated; No Manual Intervention Required.
- Extended Ball Valve Life Results from Unique Actuator Mounting and Special Valve Construction.
- Anodized Aluminum and Other Corrosion Resistant Materials are Standard.
- For High Pressure Applications, a 450 PSIG Model is Available. Contact Your Local Distributor or MBCI for Details.
- Simple Installation, Using Either Upper or Lower Condensate Entry Point. Provide for Pressure Differential Line or Whisper Vent to Assure Trouble Free Operation.
- Install at Natural Condensate Collection Points; Aftercoolers, Separators, Dryers, Receiver Tanks, Drip Legs and Intercoolers.

Miller / Bowers Co., Inc.
 1680 South Livernois
 Rochester Hills, MI 48307
 Phone: (248) 656-3605 Fax: (248) 656-3618

Your Local Distributor is:

14

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**SECTION 15220
CENTRIFUGAL PUMPS**

PART 1 - GENERAL

1.01 SUMMARY

- A. The CONTRACTOR shall supply and provide all materials, fabrication, drawings, erection, design, installation, testing and delivery of services as specified in this section and on the drawings for complete installation and proper operation of the horizontal centrifugal process pumps as part of the GAC Backup Treatment System.
- B. This section covers the requirements for the functional design, performance, materials, construction features, testing, quality and handling of the equipment described herein.
- C. It is not the intent of this section and associated drawings to specify all details of design, fabrication and construction. It shall be the responsibility of the CONTRACTOR to provide equipment that has been designed, fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service.
- D. The work includes supply, erection, delivery, complete installation and testing of horizontal centrifugal pumps as part of the Treatment System. The required pump performance requirements are listed in the attached data sheets.

1.02 SYSTEM DESCRIPTION

- A. The CONTRACTOR shall supply three centrifugal pumps (plus uninstalled spares) designed for the intended use which includes start-stop and automatic operation and pumping of treated groundwater or non-potable, clean water.
- B. The centrifugal pumps described in this section shall be installed as shown on the Contract Drawings.
- C. All pumps shall be mounted on baseplates.

1.03 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

- A. The performance requirements of the individual horizontal centrifugal pumps are specified in Attached data sheets. The horsepower and pump details are provided as guidance to the CONTRACTOR. The CONTRACTOR shall match/verify the required pump speed and horsepower to the required service per the manufacturer's recommendation.

1.04 SUBMITTALS

- A. The CONTRACTOR shall submit, in the manner and within the time limit as set forth in the contract documents, the items listed herein for all the equipment and materials furnished under this section.
- B. The CONTRACTOR's drawings shall be direct reproducibles able to produce clear, sharp, and legible prints. Fabrication of the equipment shall not be started until after the CONTRACTOR has

received written drawing review approvals from the ENGINEER.

C. Submittals to be provided include:

1. Descriptive literature bulletins, and/or catalogs of the equipment. Total weight of the equipment and operating weight, foundation requirements, including type and location of loading, size and material of anchor bolts.
2. Shop drawings showing the exact layout dimensions of the equipment, including locations, size and details of fittings and corrections. Schematic electrical diagrams specifically showing connections to field-mounted equipment.
3. A complete set of recommended spare parts based on equipment literature.
4. Operation and maintenance manuals covering all equipment.
5. Manufacturer's literature including certified pump curves, electric motor data such as horsepower rating, full load amps, motor speed, efficiency and power requirements.
6. Inspection report for routine test of each motor.

D. CONTRACTOR shall provide six (6) copies of each submittal.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Pumps used for the same service shall be of the same model line by the same manufacturer. Two identical pumps shall be provided for each application unless otherwise noted. Pumps shall meet the following specifications.
- B. Supplier shall provide centrifugal pumps with a non-overloading, TEFC motor, as specified in Attached data sheets.
- C. The pump casing shall be concentric volute, back pullout design with flanged suction and discharge connections.
- D. Pumps shall be constructed and rated for outdoor operations.
- E. The pump casing drain shall be provided with plugs.
- F. Pump gaskets and seals shall be suitable for non-potable service. The pump shall be rated for efficient operation meeting the performance requirements outlined in Attached data sheets. The pump shall be capable of intermittent and continuous operation.
- G. Pump and motor shall be rigidly mounted on baseplates. The baseplate shall be constructed of cast iron for resistance to wear, corrosion and abrasion. The baseplate shall include anchoring holes for installation as required.

- H. Supplier shall provide sufficient motor and pump supports to ensure pump reactions and other forces are not transferred to the discharge piping system.
- I. Bearings shall be grease lubricated, anti-friction, tapered roller or double row ball type. Bearings shall carry all radial and thrust loads with a minimum B-10 life expectancy of 100,000 hours as defined by the Anti-Friction Bearing Manufacturers' Association Standards. (see attached).
- J. Pumps shall be equipped with mechanical seals.
- K. Couplings for connecting pump with motor shall be made of forged steel. They shall be lubricated and flexible, sized to transmit all power from the motor to the pump over the complete operating curve and speed range. A 14 gauge stainless steel guard conforming to OSHA requirements shall be provided with the coupling.
- L. Manufacturers:
 - P-1 Backflush Pump – GOULDS 3196 or equal
 - P-2 Spray Water Pump – GOULDS 3196 or equal
 - P-3 Transfer water/Trailer Dewatering Pump – GOULDS 3196 or equal

2.02 MOTORS - GENERAL

- A. All motors shall be a NEMA frame 143T or larger. Motors shall be designed and connected for operation on a 460 volt, 3 phase, 60 hertz altering current system. Dual voltage (230/460) rated motors are acceptable.
- B. Unless otherwise required by the load, all motors shall be NEMA Design B, normal starting torque.
- C. Anti-friction motor bearings shall be designed to be regreasable and initially shall be filled with grease suitable to ambient temperature of 40 degrees C. Bearings shall be shown to be suitable for the intended application in terms of B-10 rating life, Class M3 or better.
- D. All grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary.
- E. Insulation systems shall be resistant to attack by moisture, acids, alkalis, and mechanical or thermal shock.
- F. Motors for outdoor service shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.
- G. Motors shall have a steel or cast iron frame and cast iron or stamped steel conduit box, as specified below. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking, nonhygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-in diameter, shall be provided inside the conduit box for motor frame grounding. Motors shall be totally enclosed and fan cooled. TEFC motors shall have a steel or cast iron frame, cast iron

end brackets, cast iron conduit box, 1.15 service factor at 40 degrees C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance.

- H. Minimum efficiencies for motors shall be 90%.
- I. All single speed motors over 5 horsepower shall be provided with a heavy duty industrial type power factor correction capacitor selected, recommended, and furnished by the motor manufacturer to raise the motor power factor to approximately 95 percent. The capacitor shall be mounted on the equipment base plate adjacent to the motor and shall be connected to the motor junction box with liquid tight flexible conduit.
- J. Motors shall be so constructed that they will withstand, without mechanical injury, at least 120 percent of rated speed in the forward or reverse direction in accordance with NEMA Standard MG-1.
- K. Vibration limits shall not exceed values specified in NEMA Standard MG1-12.05.
- L. Each motor shall have a suitable means for attaching grounding conductor. Supplier's standard grounding means shall be used.
- M. Capacitors shall be U.L. listed.

2.03 TOOLS AND SPARE PARTS

- A. Special tools required for normal operation and maintenance of the equipment shall be furnished with the equipment by the manufacturer.
- B. Furnish and deliver one spare pump for each application.
- C. CONTRACTOR shall obtain from manufacturer and furnish a list of additional recommended spare parts for an operating period of one year. The list shall describe each part, the quantity recommended, and the unit price of the part.

PART 3 - EXECUTION

3.01 ERECTION/INSTALLATION

- A. The equipment shall be installed in accordance with the requirements of the contract documents and the manufacturer's instructions and recommendations.
- B. All work shall be performed by competent, trained workmen, skilled in the field to which they are executing the work.
- C. All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections.

3.02 TESTING AND INSPECTIONS

- A. Each system component shall be given requisite factory tests as necessary to determine that the work

and materials are free from defects and to establish that the design and construction meet the requirements of the contract documents.

- B. Acceptance tests, after the equipment is completely installed, may be performed to demonstrate performance requirements, as specified herein. The field tests will be governed by provisions of applicable industry and institute standards.
- C. Each pump shall be tested to ensure that excessive vibration levels are not developed.
- D. Each motor shall be given factory routine test of Supplier's Initial Short Commercial Test as necessary to determine that it is free from electrical and mechanical defects, and to establish that the design and construction of the motor are satisfactory. Tests shall include rotation, megger and high potential tests.

3.03 WARRANTY

- A. Equipment shall be warranted against defects for a period of one (1) year from the date of installation.

- End of Section -

CENTRIFUGAL PUMP DATA SHEET

Item No: P-1		Project No.: 02691		Spec. No.:	
Description: Backflush Supply Pump		Project: Carbon Trl. Sys.		Location: Saugel, IL	

OPERATING CONDITIONS

CAPACITY, NORMAL 225 (GPM) RATED 225 (GPM)

DISCHARGE PRESS 21.6 (psig)

SUCTION PRESS MAX/RATED / (psig)

DIFFERENTIAL PRESS / (psig)

DIFFERENTIAL HD 50 (ft.)

NPSH AVAIL 3.7 (FT) HYDRAULIC POWER / (whp)

SERVICE: ☒ CONTINUOUS ☐ INTERMITTENT (STARTS/DAY /)

LIQUID Groundwater

TEMP 50 (°F) MAX 75 (°F)

S.G. 1.0 VISCOSITY @ MAX P.T. 1.122 (cp)

VAP. PRESS @ MAX PT. 0.26 (psia) CORR/EROS BY /

PERFORMANCE

PROPOSAL CURVE NO. /

NO. STAGES / SPEED / RPM

RATED EFF. / % RATED POWER / BHP

MAX POWER RATED IMPELLER / BHP

MAX HD RATED IMPELLER / FT

MINIMUM CONTINUOUS FLOW/THERMAL / GPM

NPSH REQ'D (H₂O) / (FT) STABLE / GPM

ROTATION (FROM CPLG END): /

REMARKS: /

CONSTRUCTION

NOZZLES	SIZE	ANSI RATING	FACING	POSITION
SUCTION	<u>4</u>	<u>A40</u>	<u>F.F.</u>	<u>Horiz.</u>
DISCHARGE	<u>3</u>	<u>/</u>	<u>F.F.</u>	<u>Vert.</u>

SERVICE CONNECTIONS	NO.	SIZE	TYPE
CASING DRAIN	<u>1</u>	<u>/</u>	<u>/</u>
VENT	<u>/</u>	<u>/</u>	<u>/</u>
PRESS GAUGE	<u>/</u>	<u>/</u>	<u>/</u>
WARM UP	<u>/</u>	<u>/</u>	<u>/</u>

CASE:

TYPE: ☒ END SUCTION ☐ VERTICAL ☐ SUMP

☐ DBL SUCTION ☐ MULTI STAGE

☐ VERTICAL ☐ CANTILEVER

SPLIT: ☐ AXIAL ☐ RADIAL

MOUNTING: ☒ FOOT ☐ IN LINE

☐ CENTERLINE ☐ VERTICAL

☐ OTHER /

PRESS. MAWP / PSIG @ / °F

MAWP / PSIG @ PUMPING TEMP.

STUFFING BOX: ☐ STD BORE ☒ LARGE BORE

☐ TAPERED BORE ☐ JACKETED

IMPELLER MTG: ☐ INDIVIDUALLY SECUR ☐ OVERHUNG

☐ BETWEEN BEARINGS

ROTATION (VIEWED FROM COUPLING END): ☐ CW ☐ CCW

SHAFT:

DIA. @ SLEEVE / (in.), COUPLING / (in.)

DIA. BETWEEN BRGS. / (in.)

SPAN BETWEEN BRG CENTERLINE / (in.)

SPAN BETWEEN BRG & IMPELLER / (in.)

COUPLINGS:

MAKE / MODEL /

RATING (HP/100 RPM) /

LUBRICATION /

LIMITED END FLOAT REQ'D /

SPACER LENGTH / (in.) SERV. FACTOR /

DYNAMIC BALANCED AGMA BLANCE CLASS ☐ PUMP MFR.

☐ DRIVER ☐ PURCHASER ☐ CPLG PER API 671

REMARKS: /

MATERIALS

TABLE H-1 CLASS /

BARREL/CASE D.I. IMPELLER 316 SS

CASE/IMPELLER WEAR RINGS /

SHAFT CS SLEEVE 316 SS

DIFFUSERS / COUPLING HUBS /

COUPLING SPACER/DIAPHRAGMS /

BASEPLATE NO./MATL. / Cast Iron

☐ VERTICAL LEVELING SCREWS

☐ HORIZONTAL POSITIONING SCREWS

STUFFING BOX /

BEARINGS AND LUBRICATION

BEARING: (TYPE/NO.) /

RADIAL /

THRUST /

LUBRICATION

☐ GREASE ☒ OIL FLOOD ☐ RING OIL

☐ FLINGER ☐ PURGE OIL MIST ☐ PURE OIL MIST

☐ CONSTANT LEVEL OILER

☐ PRESSURE ☐ API-611 ☐ API-614

☐ OIL VISCOSITY, GRADE /

OIL HEATER REQ'D ☐ ELECT. / ☐ STEAM

MOTOR DRIVE

MFR / HP 7.5

RPM 1800 FRAME / SF 1.15

☒ HORIZONTAL ☐ VERTICAL

VOLTS/PHASE/HERTZ 460 / 3 / 60

TYPE / ENCLOSURE TEFC

INSULATION F BEARINGS /

LUBE / TEMP RISE /

MIN. STARTING VOLTAGE / FULL LOAD AMPS /

LOCKED ROTOR AMPS /

STARTING METHOD /

VERTICAL THRUST CAP

UP / (lbs.)

DOWN / (lbs.)

REMARKS NON-OVERLOADING MOTOR REQUIRED

Revision: C		Date: 7/23/03	Sheet 1 of 2	Prepared By: MMH
--------------------	--	----------------------	----------------------------	-------------------------

C	Contingency Plan				
B	Pre-final Design				
A	For Review				
ISSUE	DESCRIPTION	CHRD	APP'D	CLIENT	

The ADVENT Group, Inc.



Solutia Inc.
St. Louis, MO

CENTRIFUGAL PUMP DATA SHEET (CONT.)

Item No.: <u>P-1</u>	Project No.: <u>02691</u>	Spec. No.: _____
Description: <u>Backflush Supply Pump</u>	Project: <u>Carbon Trf. Sys.</u>	Location: <u>Saugel, IL</u>

SEAL INFORMATION	TEST AND INSPECTION												
<p>SEAL DATA:</p> <p>MFR _____</p> <p>MODEL _____</p> <p>TYPE <u>Single Mechanical</u></p> <p>SEAL CONSTRUCTION</p> <p><input checked="" type="radio"/> CARTRIDGE MOUNT</p> <p><input type="radio"/> NO SLEEVE</p> <p><input type="radio"/> HOOKED SLEEVE OR NON-CARTRIDGE</p> <p><input type="radio"/> PUMPING RING</p> <p>SLEEVE MAT'L: <u>316 SS</u></p> <p>GLAND MAT'L: <u>316 SS</u></p> <p>AVX SEAL DEVICE: <u>No</u></p> <p>JACKET REQ'D: <u>No</u></p> <p>OTHER REMARKS: <u>Provide silicon carbide/silicon carbide seal facing.</u></p>	<table style="width: 100%;"> <tr> <th style="text-align: left;">TEST</th> <th style="text-align: center;">NON WIT.</th> <th style="text-align: center;">WIT.</th> </tr> <tr> <td>PERFORMANCE</td> <td style="text-align: center;"><input checked="" type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> </tr> <tr> <td>HYDROSTATIC</td> <td style="text-align: center;"><input checked="" type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> </tr> <tr> <td>NPSH</td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> </tr> </table> <p><input type="radio"/> COMPLETE UNIT TEST</p> <p><input type="radio"/> DISMANTLE AND INSPECT AFTER TEST</p> <p><input type="radio"/> FINAL INSPECTION</p> <p><input type="radio"/> 7-DAY NOTIFICATION REQ'D</p> <p>REMARKS: <u>Provide Certified Performance Curve</u></p>	TEST	NON WIT.	WIT.	PERFORMANCE	<input checked="" type="radio"/>	<input type="radio"/>	HYDROSTATIC	<input checked="" type="radio"/>	<input type="radio"/>	NPSH	<input type="radio"/>	<input type="radio"/>
TEST	NON WIT.	WIT.											
PERFORMANCE	<input checked="" type="radio"/>	<input type="radio"/>											
HYDROSTATIC	<input checked="" type="radio"/>	<input type="radio"/>											
NPSH	<input type="radio"/>	<input type="radio"/>											

ADDITIONAL COMMENTS:

					Revision: <u>C</u>	Date: <u>7/23/03</u>	Sheet <u>1</u> of <u>2</u>	Prepared By: <u>MMH</u>
C	Contingency Plan				 The ADVENT Group, Inc.		 Solutia Inc. St. Louis, MO	
B	Pre-Final Design							
A	For Review							
ISSUE	DESCRIPTION	CHK'D	APP'D	CLIENT				

CENTRIFUGAL PUMP DATA SHEET

Item No.: P-2	Project No.: 02691	Spec. No.:
Description: Spray Water Pump	Project: Carbon Trt. Sys.	Location: Sauget, IL

OPERATING CONDITIONS

CAPACITY, NORMAL 100 (GPM) RATED 100 (GPM)
 DISCHARGE PRESS 77.9 (psig)
 SUCTION PRESS MAX/RATED / (psig)
 DIFFERENTIAL PRESS / (psig)
 DIFFERENTIAL HD 180 (ft.)
 NPSH AVAIL 5 (FT) HYDRAULIC POWER / (whp)
 SERVICE: ☒ CONTINUOUS ☐ INTERMITTENT (STARTS/DAY <1)
 LIQUID Groundwater
 TEMP 70 (°F) MAX / (°F)
 S.G. 1.0 VISCOSITY @ MAX P.T. 1.122 (cp)
 VAP. PRESS @ MAX PT. 0.26 (psia) CORR/EROS BY /

PERFORMANCE

PROPOSAL CURVE NO. /
 NO. STAGES / SPEED / RPM
 RATED EFF. / % RATED POWER / BHP
 MAX POWER RATED IMPELLER / BHP
 MAX HD RATED IMPELLER / FT
 MINIMUM CONTINUOUS FLOW: THERMAL / GPM
 NPSH REQ'D (H₂O) / (FT) STABLE 14.1 GPM
 ROTATION (FROM CPLG END): /
 REMARKS: /

CONSTRUCTION

NOZZLES	SIZE	ANSI RATING	FACING	POSITION
SUCTION	<u>3</u>	<u>AB</u>	<u>F.F.</u>	<u>Horiz.</u>
DISCHARGE	<u>1.5</u>	<u>/</u>	<u>F.F.</u>	<u>Vert.</u>

SERVICE CONNECTIONS	NO.	SIZE	TYPE
CASING DRAIN	<u>1</u>	<u>/</u>	<u>NPT</u>
VENT	<u>/</u>	<u>/</u>	<u>/</u>
PRESS GAUGE	<u>/</u>	<u>/</u>	<u>/</u>
WARM UP	<u>/</u>	<u>/</u>	<u>/</u>

CASE:

- TYPE: ☒ END SUCTION ☐ VERTICAL ☐ SUMP
☐ DBL SUCTION ☐ MULTI STAGE
☐ VERTICAL ☐ CANTILEVER
 SPLIT: ☐ AXIAL ☒ RADIAL
 MOUNTING: ☒ FOOT ☐ IN LINE
☐ CENTERLINE ☐ VERTICAL
☐ OTHER /

PRESS. MAWP / PSIG @ / °F
 MAWP / PSIG @ PUMPING TEMP.

- STUFFING BOX: ☐ STD BORE ☒ LARGE BORE
☐ TAPERED BORE ☐ JACKETED
 IMPELLER MTG: ☐ INDIVIDUALLY SECUR ☐ OVERHUNG
☐ BETWEEN BEARINGS

ROTATION (VIEWED FROM COUPLING END): ☐ CW ☐ CCW

SHAFT:

DIA. @ SLEEVE / (in.), COUPLING / (in.)
 DIA. BETWEEN BRGS. / (in.)
 SPAN BETWEEN BRG CENTERLINE / (in.)
 SPAN BETWEEN BRG & IMPELLER / (in.)

COUPLINGS:

MAKE / MODEL /
 RATING (HP/100 RPM) /
 LUBRICATION /
 LIMITED END FLOAT REQ'D /
 SPACER LENGTH / (in.) SERV. FACTOR /
 DYNAMIC BALANCED AGMA BLANCE CLASS ☐ PUMP MFR.
☐ DRIVER ☐ PURCHASER ☐ CPLG PER API 671

REMARKS:

MATERIALS

TABLE H-1 CLASS

BARREL/CASE D.I. IMPELLER 316 SS
 CASE/IMPELLER WEAR RINGS /
 SHAFT C5 SLEEVE 316 SS
 DIFFUSERS / COUPLING HUBS /
 COUPLING SPACER/DIAPHRAGMS /
 BASEPLATE NO./MATL. / Cast Iron
☐ VERTICAL LEVELING SCREWS
☐ HORIZONTAL POSITIONING SCREWS
 STUFFING BOX /

BEARINGS AND LUBRICATION

BEARING: (TYPE/NO.)

RADIAL /

THRUST /

LUBRICATION

- ☐ GREASE ☒ OIL FLOOD ☐ RING OIL
☐ FLINGER ☐ PURGE OIL MIST ☐ PURE OIL MIST
☐ CONSTANT LEVEL OILER
☐ PRESSURE ☐ API-611 ☐ API-614
☐ OIL VISCOSITY, GRADE /
 OIL HEATER REQ'D ☐ ELECT. ☐ STEAM

MOTOR DRIVE

MFR / HP 10
 RPM 3500 FRAME / SF 1.15
☒ HORIZONTAL ☐ VERTICAL
 VOLTS/PHASE/HERTZ 460 / 3 / 60
 TYPE / ENCLOSURE TEFC
 INSULATION F BEARINGS /
 LUBE / TEMP RISE /
 MIN. STARTING VOLTAGE / FULL LOAD AMPS /
 LOCKED ROTOR AMPS /
 STARTING METHOD /
 VERTICAL THRUST CAP
 UP / (lbs.)
 DOWN / (lbs.)
 REMARKS NON-OVERLOADING MOTOR REQUIRED

				Revision: C	Date: 7/23/03	Sheet 1 of 2	Prepared By: MMH
C	Contingency Plan				 The ADVENT Group, Inc.		
B	Pre-final Design						
A	For Review						
ISSUE	DESCRIPTION	CHK'D	APP'D	CLIENT			
 Solutia Inc. St. Louis, MO							



CENTRIFUGAL PUMP DATA SHEET (CONT.)

Item No.: P-2	Project No.: 02691	Spec. No.:
Description: Spray Water Pump	Project: Carbon Trt. Sys.	Location: Sauget, IL

SEAL INFORMATION	TEST AND INSPECTION												
SEAL DATA: MFR: _____ MODEL: _____ TYPE: <u>Single Mechanical</u>	<table style="width: 100%;"> <tr> <td style="width: 33%;">TEST</td> <td style="width: 33%;">NON WIT.</td> <td style="width: 33%;">WIT.</td> </tr> <tr> <td>PERFORMANCE</td> <td style="text-align: center;">●</td> <td style="text-align: center;">○</td> </tr> <tr> <td>HYDROSTATIC</td> <td style="text-align: center;">●</td> <td style="text-align: center;">○</td> </tr> <tr> <td>NPSH</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> </table>	TEST	NON WIT.	WIT.	PERFORMANCE	●	○	HYDROSTATIC	●	○	NPSH	○	○
TEST	NON WIT.	WIT.											
PERFORMANCE	●	○											
HYDROSTATIC	●	○											
NPSH	○	○											
SEAL CONSTRUCTION <input checked="" type="radio"/> CARTRIDGE MOUNT <input type="radio"/> NO SLEEVE <input type="radio"/> HOOKED SLEEVE OR NON-CARTRIDGE <input type="radio"/> PUMPING RING	<input type="radio"/> COMPLETE UNIT TEST <input type="radio"/> DISMANTLE AND INSPECT AFTER TEST <input type="radio"/> FINAL INSPECTION <input type="radio"/> 7-DAY NOTIFICATION REQ'D												
SLEEVE MAT'L: <u>316 SS</u> GLAND MAT'L: <u>316 SS</u> AVX SEAL DEVICE: <u>No</u> JACKET REQ'D: <u>No</u> OTHER REMARKS: _____ 	REMARKS: <u>Provide Certified Performance Curve</u> 												

ADDITIONAL COMMENTS:

					Revision: C	Date: 7/23/03	Sheet: 1 of 2	Prepared By: MMH
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C	Contingency Plan				 The ADVENT Group, Inc.	 Solutia Inc. St. Louis, MO
B	Pre-Final Design					
A	For Review					
ISSUE	DESCRIPTION	CHK'D	APP'D	CLIENT		

CENTRIFUGAL PUMP DATA SHEET

Item No: P-3	Project No.: 02691	Spec. No.:
Description: Trailer Dewatering Pump	Project: Carbon Trl. Sys.	Location: Saugel, IL

OPERATING CONDITIONS

CAPACITY, NORMAL 100 (GPM) RATED 100 (GPM)
 DISCHARGE PRESS 41.1 (psig)
 SUCTION PRESS MAX/RATED / (psig)
 DIFFERENTIAL PRESS / (psig)
 DIFFERENTIAL HD 95 (ft.)
 NPSH AVAIL 3.0 (FT) HYDRAULIC POWER / (whp)
 SERVICE: ☒ CONTINUOUS ☐ INTERMITTENT (STARTS/DAY <1)
 LIQUID Groundwater
 TEMP 70 (°F) MAX / (°F)
 S.G. 1.0 VISCOSITY @ MAX P.T. 1.122 (cp)
 VAP. PRESS @ MAX PT. 0.26 (psia) CORR/EROS BY /

PERFORMANCE

PROPOSAL CURVE NO. /
 NO. STAGES / SPEED / RPM
 RATED EFF. / % RATED POWER / BHP
 MAX POWER RATED IMPELLER / BHP
 MAX HD RATED IMPELLER / FT
 MINIMUM CONTINUOUS FLOW: THERMAL / GPM
 NPSH REQ'D (H₂O) / (FT) STABLE 14.1 GPM
 ROTATION (FROM CPLG END): /
 REMARKS: /

CONSTRUCTION

NOZZLES	SIZE	ANSI RATING	FACING	POSITION
SUCTION	3	AB	F.F.	Horiz.
DISCHARGE	2		F.F.	Vert.

SERVICE CONNECTIONS	NO.	SIZE	TYPE
CASING DRAIN	1		NPT
VENT			
PRESS GAUGE			
WARM UP			

CASE:

TYPE: ☒ END SUCTION ☐ VERTICAL ☐ SUMP
☐ DBL SUCTION ☐ MULTI STAGE
☐ VERTICAL ☐ CANTILEVER
 SPLIT: ☐ AXIAL ☒ RADIAL
 MOUNTING: ☒ FOOT ☐ IN LINE
☐ CENTERLINE ☐ VERTICAL
☐ OTHER /
 PRESS. MAWP / PSIG @ / °F
 MAWP / PSIG @ PUMPING TEMP.

STUFFING BOX: ☐ STD BORE ☒ LARGE BORE
☐ TAPERED BORE ☐ JACKETED

IMPELLER MTG: ☐ INDIVIDUALLY SECUR ☐ OVERHUNG
☐ BETWEEN BEARINGS

ROTATION (VIEWED FROM COUPLING END): ☐ CW ☐ CCW

SHAFT:

DIA. @ SLEEVE / (in.), COUPLING / (in.)
 DIA. BETWEEN BRGS. / (in.)
 SPAN BETWEEN BRG CENTERLINE / (in.)
 SPAN BETWEEN BRG & IMPELLER / (in.)

COUPLINGS:

MAKE / MODEL /
 RATING (HP/100 RPM) /
 LUBRICATION /
 LIMITED END FLOAT REQ'D /
 SPACER LENGTH / (in.) SERV. FACTOR /
 DYNAMIC BALANCED AGMA BLANCE CLASS ☐ PUMP MFR.
☐ DRIVER ☐ PURCHASER ☐ CPLG PER API 671

REMARKS: /

MATERIALS

TABLE H-1 CLASS

BARREL/CASE D.I. IMPELLER 316 SS
 CASE/IMPELLER WEAR RINGS /
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 COUPLING SPACER/DIAPHRAGMS /
 BASEPLATE NO./MATL. / Cast iron
☐ VERTICAL LEVELING SCREWS
☐ HORIZONTAL POSITIONING SCREWS
 STUFFING BOX /

BEARINGS AND LUBRICATION

BEARING: (TYPE/NO.)

RADIAL /
 THRUST /


LUBRICATION

☐ GREASE ☒ OIL FLOOD ☐ RING OIL
☐ FLINGER ☐ PURGE OIL MIST ☐ PURE OIL MIST
☐ CONSTANT LEVEL OILER
☐ PRESSURE ☐ API-611 ☐ API-614
☐ OIL VISCOSITY, GRADE /
 OIL HEATER REQ'D ☐ ELECT. / ☐ STEAM


MOTOR DRIVE

MFR / HP 10
 RPM 1750 FRAME / SF 1.15
☒ HORIZONTAL ☐ VERTICAL
 VOLTS/PHASE/HERTZ 460 1 3 1 60
 TYPE / ENCLOSURE TEFC
 INSULATION F BEARINGS /
 LUBE / TEMP RISE /
 MIN. STARTING VOLTAGE / FULL LOAD AMPS /
 LOCKED ROTOR AMPS /
 STARTING METHOD /
 VERTICAL THRUST CAP
 UP / (lbs.)
 DOWN / (lbs.)
 REMARKS NON-OVERLOADING MOTOR REQUIRED

Revision: C				Date: 7/23/03	Sheet 1 of 2	Prepared By: MMH
C	Contingency Plan					
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A	For Review					
ISSUE	DESCRIPTION	CHK'D	APP'D	CLIENT		



The ADVENT Group, Inc.





Solutia Inc.
St. Louis, MO

CENTRIFUGAL PUMP DATA SHEET (CONT.)

Item No: P-3	Project No.: 02691	Spec. No.:
Description: Trailer Dewatering Pump	Project: Carbon Trt. Sys.	Location: Saugee, IL

SEAL INFORMATION	TEST AND INSPECTION												
<p>SEAL DATA:</p> <p>MFR _____</p> <p>MODEL _____</p> <p>TYPE <u>Single Mechanical</u></p> <p>SEAL CONSTRUCTION</p> <p><input checked="" type="radio"/> CARTRIDGE MOUNT</p> <p><input type="radio"/> NO SLEEVE</p> <p><input type="radio"/> HOOKED SLEEVE OR NON-CARTRIDGE</p> <p><input type="radio"/> PUMPING RING</p> <p>SLEEVE MAT'L: <u>316 SS</u></p> <p>GLAND MAT'L: <u>316 SS</u></p> <p>AVX SEAL DEVICE: <u>No</u></p> <p>JACKET REQ'D: <u>No</u></p> <p>OTHER REMARKS: _____</p> <p>_____</p> <p>_____</p>	<table style="width: 100%;"> <tr> <td style="width: 33%;">TEST</td> <td style="width: 33%;">NON WIT.</td> <td style="width: 33%;">WIT.</td> </tr> <tr> <td>PERFORMANCE</td> <td style="text-align: center;">•</td> <td style="text-align: center;">○</td> </tr> <tr> <td>HYDROSTATIC</td> <td style="text-align: center;">•</td> <td style="text-align: center;">○</td> </tr> <tr> <td>NPSH</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> </table> <p><input type="radio"/> COMPLETE UNIT TEST</p> <p><input type="radio"/> DISMANTLE AND INSPECT AFTER TEST</p> <p><input type="radio"/> FINAL INSPECTION</p> <p><input type="radio"/> 7-DAY NOTIFICATION REQ'D</p> <p>REMARKS: <u>Provide Certified Performance Curve</u></p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	TEST	NON WIT.	WIT.	PERFORMANCE	•	○	HYDROSTATIC	•	○	NPSH	○	○
TEST	NON WIT.	WIT.											
PERFORMANCE	•	○											
HYDROSTATIC	•	○											
NPSH	○	○											

ADDITIONAL COMMENTS:

					Revision: C	Date: 7/2/303	Sheet 1 of 2	Prepared By: MMH
C	Contingency Plan				 The ADVENT Group, Inc.		 Solutia Inc. St. Louis, MO	
B	Pre-Final Design							
A	For Review							
ISSUE	DESCRIPTION	CHK'D	APP'D	CLIENT				

**SECTION 15221
PIPES AND PIPE FITTINGS**

PART 1 - GENERAL

1.01 SUMMARY

- A. The CONTRACTOR shall supply and provide all materials (unless otherwise noted), layout drawings, spool piece drawings, bill of materials, fabrication drawings, erection design, installation, testing and delivery of services as specified in this section and/or on the drawings for complete installation and proper operation of all pipes and fittings as included in the contract documents.
- B. This section covers the requirements for the functional design, performance, materials, construction features, testing, quality and handling of the equipment described herein.
- C. It is not the intent of this section and associated drawings to specify all details of design, fabrication and construction. It shall be the responsibility of the CONTRACTOR to provide complete and operational equipment and systems as described herein.

1.02 SYSTEM DESCRIPTION

- A. The work includes supply, erection, complete installation and testing of the following:
 - 1. Carbon Steel pipes and fittings
 - 2. Ductile Iron pipes and Cast Iron fittings
 - 3. Galvanized Steel pipes and fittings
 - 4. Flexible hose and fittings

1.03 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

- A. The CONTRACTOR shall verify and certify that all pipe and hose materials are suitable for their intended use.

1.04 SUBMITTALS

- A. The CONTRACTOR shall submit, in the manner and within the time limit as set forth in the Contract documents, shop drawings showing outline and overall dimensions, connection details, weights, anchorage details, arrangement of functional parts, and parts lists if applicable, for all equipment and materials furnished.
- B. The CONTRACTOR's drawings shall be direct reproducibles able to produce clear, sharp, and legible prints. Fabrication of the equipment shall not be started until after the CONTRACTOR has received written drawing review approvals from the ENGINEER.

- C. Review of the drawings by the ENGINEER shall not relieve the CONTRACTOR of the entire responsibility for the engineering, design, workmanship and material under the contract documents.
- D. Submittals Register - The following shall be submitted in accordance with Section 01300- Submittal.
 - 1. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction.

PART 2 - PRODUCTS

2.01 EQUIPMENT

2.02 PIPE MATERIALS

- A. All Carbon Steel piping shall conform to ASTM A53 Type F (2" diameter and smaller), ASTM A53 Type E Grade B (2 ½" diameter and larger). All Carbon Steel piping shall be schedule 40 unless otherwise noted. Fittings for all Carbon Steel piping shall be constructed of schedule 40 carbon steel with buttweld ends and shall conform to ASTM A234 Grade WPB and ASME B16.9. Flanges shall be Class 150 carbon steel with a standard weight weldneck per STM A105 and ASME B16.5. Gaskets for all flanged connections shall be 1/16" non-asbestos ring type.
- B. All Ductile Iron piping shall conform to ANSI specification A-21.51 with Class 125 flanged joints. Piping shall be cement lined inside and coated with an exterior asphalt seal coat as per ANSI A-21.4. Fittings for Ductile Iron piping shall be cast iron with Class 125 flanged ends. Gaskets for all flanged connections shall be a 1/16" rubber type suitable for water pipe service.
- C. All Galvanized Steel piping shall be seamless or welded schedule 40 carbon steel conforming to ASTM A53 Grade B. All pipe under this specification shall be galvanized coated with zinc inside and outside by the hot-dip process. Zinc used for this coating shall be of any grade conforming to specification B6. Coating specifications shall conform to ASTM A53, Section 19. All joints shall be threaded. All fitting shall be malleable iron, 150 pound threaded type in accordance with ANSI B16.3. Material shall conform to ASTM A197. All fittings shall be hot-dipped zinc coated to conform with ASTM A53 or have electrodeposited zinc coating conforming to ASTM B633 Type I, Service Condition 4.
- D. Flexible Piping conveying water shall conform to the following criteria:
 - 1. Flexible piping with a nominal inside diameter of less than 2.5 inches shall have a Maximum Working Pressure of 300 psi. 3-inch I.D. hose shall have a Maximum Working Pressure of 250 psi. 4-inch I.D. hose shall have a Maximum Working Pressure of 200 psi.
 - 2. All mass couplings shall be constructed of aluminum. The coupler on the hose shall be a female hose shank to connect with a male adapter.
 - 3. Hoses shall be constructed of thermoplastic vinyl nitrile reinforced with 100%

polyester and helical wire.

- E. Flexible Piping conveying air shall conform to the following criteria:
1. Flexible piping with a nominal I.D. of ¾ inches shall have Maximum Working Pressure of 150 psi. 1 ½ inch I.D. hose shall have a Maximum Working Pressure of 200 psi.
 2. All mass couplings shall be constructed of aluminum. The coupler on the hose shall be a female hose shank to connect with a male adapter.
 3. All ¾ inch hoses shall be constructed of EPDM, RMA Class C with multi-spiral polyester yarn reinforcement. All 1 ½ inch hoses shall be constructed of an oil resistant rubber with multi-spiral polyester yarn reinforcement.

2.03 COATINGS

- A. Surface preparation of all Carbon Steel piping shall be completed per SSPC-SP2.
- B. The prime coating shall be a single coat of an alkyd resin type (Sherwin Williams Kem Kromik Universal Metal Primer or equal) applied to a dry film thickness of 4.0 millimeters.
- C. The finish coating shall be two coats of an alkyd type (Sherwin Williams Industrial Enamel HS or equal) applied to a dry film thickness of 4.0 millimeters per coat.

PART 3 - EXECUTION

3.01 ERECTION/INSTALLATION

- A. The equipment shall be installed and/or erected in accordance with the requirements of the Contract documents and the manufacturer's instructions and recommendations.
- B. All work shall be performed by competent, trained workmen, skilled in the field to which they are executing work.
- C. All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections. All pipes and fittings shall be installed true to alignment, rigidly supported and fitted accurately.
- D. Flange covers should not be removed until flanges are ready to be bolted into position or sealing faces may become damaged or distorted. If covers are removed for inspection purposes, they should be replaced immediately.
- E. Flanged joints shall be made up tight, and measures taken to prevent undue strain upon adjacent pieces such as pumps, valves and other piping. Before the pieces are assembled, CONTRACTOR shall remove rust preventive coatings from machined surfaces, thoroughly clean pipe ends and gaskets and carefully smooth all burrs and other defects. The flanged bolt holes on each end of flanged pipe and fittings shall accurately straddle the same horizontal and vertical centerlines, unless special drilling is required.

- F. Bolts should be tightened using proper bolt torques as recommended by the manufacturer. Threads must be clean and well lubricated and washers should be used to ensure correct torque. Bolts should be tightened alternatively and evenly.
- G. If a flange leak occurs and the bolts of the leaking side have been properly torqued, they should not be tightened further or permanent damage to the sealing face may result. Instead, the bolts on the opposite side should be loosened a half turn at a time and then the bolts on the leaking side should be tightened by the same amount. If the leak persists, the bolts should be removed and the sealing faces should be examined for scratches or dents across an entire face which could provide a leak path and appropriate measures taken such as polishing the flange face.
- H. Carbon steel piping that is located on the manifold shall be insulated using 1 ½ inch fiberglass insulation in an aluminum jacket. All carbon steel piping shall be heat traced and insulated as specified on the piping drawings..

3.02 TESTING AND INSPECTIONS

- A. Each system component will be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of the contract documents.
- B. Acceptance tests, after the equipment is completely installed, may be performed to demonstrate performance requirements as specified herein. The field tests will be governed by provisions of applicable industry and institute standards.
- C. Hydrostatic Testing
 - 1. Each assembled system shall be flushed clean with water and hydrostatically tested at 1.5 times the design pressure but not to exceed 98% of the rated operating pressure of each pipe. Water for testing shall be potable water.
 - 2. All tubing and piping connections, welds and valve stems and seats shall be checked for leaks. No leakage shall be permitted. All leaks shall be repaired and the equipment retested.
 - 3. Following the piping hydrostatic test, the instrument devices shall be connected and hydrostatically tested for a minimum period of five minutes. During the test, all instrument devices shall be subjected to a pressure no greater than the lowest pressure rated instrument. CONTRACTOR shall be responsible for proper protection of instrument.
 - 4. All hydrostatic tests and all radiographic, liquid penetrant and magnetic particle inspections that may be required are to be completed and approved prior to any application of final equipment coatings. Equipment and nozzle interiors are to be inspected and approved for adequate cleanliness and smoothness prior to any coating application. All sandblasting or other abrasive cleaning operations must be done prior to hydrostatic test. All surfaces to be lined or coated are to be thoroughly dried before coating. Should rusting occur on blasted surfaces prior

to application of coating, the surfaces shall be reblasted in accordance with specifications in Section 2.03.

- E. CONTRACTOR shall ensure pipe and pipe fittings, solvents and joints are compatible with the operating chemicals and surrounding environment.

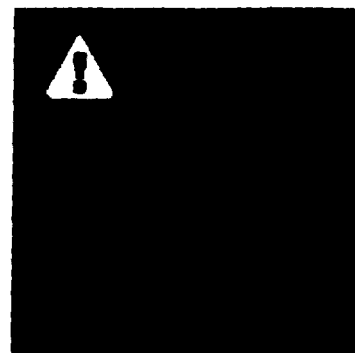
3.03 **WARRANTY**

Equipment shall be guaranteed against manufacturer defects for a period of one year from the date of installation.

-- End of Section --

[Back to Multi Purpose Hose Catalog](#)[Back to Liquid & Dry Hose Catalog](#)**ROYALFLEX 1196**

TUBE and COVER	Thermoplastic Vinyl Nitrile
REINFORCEMENT	100% polyester and helical wire
COLOR	Blue
TEMP. RANGE	-20°F to +180°F
WORKING PRES.	200-300 PSI (Depends on coupling)
SUCTION	Full Vacuum
COUPLING	Long Shank, Cam and Groove, Interlocking, or Swaged. Clamps - Interlocking, Band or Dixon Holedall II. For permanently attached coupling, contact Boston.



FEATURES	ADVANTAGES	MARKETS	APPLICATIONS
Thermoplastic vinyl nitrile tube and cover	Abrasion, some chemical and heat resistance	Agriculture	Transfer of water, liquid diluted fertilizers and pesticides. Pumping, suction, and discharge of water and slurries
Ribbed cover	Sure grip	Construction	
More turns of helical wire per inch	More crush and kink resistant	Foundries	
Higher working pressures	300 PSI applications	Mining	
Light weight	Easy to handle	Oil Exploration/	
Flexible		Drilling Paper	
Longer lengths	Economical; eliminates couplings	Industry	
MSHA approved	Schedule 26 and conditions outlined in Federal Register Volume 35	Petroleum/Petrochemical Tank Truck Waste Hauling Waste Treatment Plant	

Code	Nominal I.D.		Nominal O.D.		Approx. Weight w/o Fittings		Maximum Recommended Working Press.		Minimum Recommended Bend Radius	
	(In.)	(mm)	(In.)	(mm)	Lbs./ft	Kg/m	(PSI)	(BARS)	(In.)	(mm)
42-1196-15	1 1/2	38.1	2	50.8	.81	1.026	300	20.68	6	152
42-1196-20	2	50.8	2 1/2	63.5	1.09	1.622	300	20.68	8	203

42-1196-25	2 1/2	63.5	3	76.2	1.32	1.965	300	20.68	10	254
42-1196-30	3	76.2	3 1/2	88.9	1.94	2.887	250	17.24	12	305
42-1196-40	4	102.0	4 1/2	115.9	2.27	2.72	200	13.79	16	406

Available in 50, 60, 100, 120 ft. lengths

**Warning**

Before using any hoses in this section, consult the safety page and the chemical resistance chart or the Boston Hose Chemical Resistance Guidelines. If you need a printed copy please call Customer Service at 1-800-251-1410

Important Information, (C) Copyright 1998, Dana Corporation

RED VALUFLEX[®] - 30°F - 180°F

Sizes: 1/4" through 1 1/2" I.D.
Working Pressure: 150#, 200#, 250# and 300#
Branding: White Ink; Size-WP-Made in USA
Oil Resistance: Limited
Construction:
Tube: EPDM, RMA Class C
Reinforcement: 2 and 4 spiral polyester yarn
Cover: EPDM

I.D. (in.)	O.D. (in.)	Working Pressure	Service	Approx. Wt./C Ft.
1/4	1/2	150	ND	9.1
1/4	1/2	200	HD	14.0
1/4	3/8	300	XHD	17.3
3/8	1 1/32	150	ND	12.8
3/8	1 1/32	200	HD	14.7
3/8	5/8	300	XHD	15.5
1/2	1 1/8	150	ND	16.7
1/2	1 1/8	200	HD	17.1
1/2	2 1/32	300	XHD	20.0
1/2	1 3/8	150	ND	20.9
1/2	7/8	200	HD	26.0
1/2	7/8	300	XHD	27.6
5/8	1 5/8	150	ND	25.0
5/8	1	200	HD	28.5
5/8	1	300	XHD	32.9
3/4	1 1/4	150	ND	35.5
3/4	1 1/32	200	HD	36.4
3/4	1 5/32	250	XHD	37.3
3/4	1 3/8	300	XHD	40.3
1	1 3/8	150	HD	41.8
1	1 7/8	200	XHD	50.3
1 1/4	2 1/32	150	XHD	70.5
1 1/2	2 1/32	150	XHD	83.4
2	2 1/2	150	XHD	124.0

GREEN VALUFLEX[®]

Sizes: 3/8", 1/2" and 3/4"
Working Pressure: 250#
Branding: White Ink; Size-WP-Made in USA
Oil Resistance: Limited
Construction:
Tube: EPDM, RMA Class C
Reinforcement: 4 spiral polyester yarn
Cover: EPDM

I.D. (in.)	O.D. (in.)	Working Pressure	Service	Approx. Wt./C Ft.
3/8	2 1/32	250	XHD	20.0
1/2	3/8	250	XHD	27.6
3/4	1 1/32	250	XHD	36.5

MAINLINER™

Mainliner is designed to handle the oil laden mists used to lubricate pneumatic tools. It features a medium oil resistant tube with a multi-spiral polyester reinforcement that keeps the hose flexible even in extreme temperatures. The cover resists abrasion, cracking, weathering and ozone. Constant working pressures of 200, 250 and 300 psi make Mainliner the quality choice for a general service hose. It is not recommended for handling fuels.

Sizes: ¼" through 1½" I.D.
Working Pressure: 200#, 250# and 300#
Branding: Blue Ink: Size-WP-Made in USA
Cover Colors: Red. Other colors available
Oil Resistance: Medium
Construction:
Tube: Medium oil resistant
Reinforcement: 2 and 4 spiral polyester yarn
Cover: Limited oil resistant

I.D. (in.)	O.D. (in.)	Working Pressure	Service	Approx. Wt./C Ft.
¼	½	200	HD	9.3
¼	¾	300	XHD	16.6
⅝	¾	300	XHD	15.0
¾	1⅛	200	HD	17.1
¾	1⅜	300	XHD	19.1
½	1⅝	200	HD	21.3
½	1⅞	300	XHD	26.6
⅝	1	300	XHD	31.8
¾	1⅞	200	HD	36.4
¾	1⅞	250	XHD	37.3
¾	1⅞	300	XHD	40.8
1	1⅞	200	HD	43.0
1	1⅞	300	XHD	52.5
1¼	2⅜	200	XHD	73.0
1½	2⅝	200	XHD	86.4

AIRFLEX™

Airflex is a quality pneumatic air tool hose to use when lubricating tools with an oil mist through air lines. It features a medium oil resistant tube with a multi-spiral polyester reinforcement. The highly visible yellow cover is weather, ozone and abrasion resistant. Airflex has a constant working pressure of 300 psi through all sizes. It is not recommended for handling fuels.

Sizes: ¼" through ¾" I.D.
Working Pressure: 300#
Branding: Blue Ink: Size-WP-Airflex-Made in USA
Cover Color: Yellow
Oil Resistance: Medium
Construction:
Tube: Medium oil resistant
Reinforcement: 4 spiral polyester yarn
Cover: Limited oil resistant

I.D. (in.)	O.D. (in.)	Working Pressure	Service	Approx. Wt./C Ft.
¼	¾	300	XHD	16.6
⅝	¾	300	XHD	19.2
½	¾	300	XHD	26.8
¾	1⅞	300	XHD	37.4

SECTION 15222 VALVES

PART 1 - GENERAL

1.01 SUMMARY

This includes all manual valves incorporated into the GAC Backup System.

PART 2 - PRODUCTS

2.01 EQUIPMENT

Type	Size	Ends	Materials	Mfr./Model
Gate	2" and smaller	Threaded	Cast iron or bronze body, bronze trim	Crane 490, Powell 500 Crane 465 1/2, Powell 1793
	2 1/2" - 24"	Flanged	Cast iron body, bronze trim and stem	
Swing Check	2" and smaller	Threaded	Bronze body, brass or bronze disc	Crane 37, Powell 560 Crane 373, Powell 559
	2 1/2" - 24"	Flanged	Cast iron body, bronze disc	
Butterfly	2 1/2" - 24"	Flanged	Cast iron body, aluminum bronze disc, Buna N seats	Crane 42
Ball	2" and smaller	Threaded	Bronze body, brass ball, TFE seats	Jamesbury A11TT, Crane 9302, Apollo 70-10X Jamesbury 5150-31-XXXX, Apollo 88-10X
	2 1/2" - 24"	Flanged	Carbon steel body, chrome-plated steel ball, TFE seats	

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections. All pipes, valves, and fittings shall be installed true to alignment, rigidly supported and fitted accurately.
- B. Flanged joints shall be made up tight, and measures taken to prevent undue strain upon adjacent pieces such as pumps, valves and other piping. Before the pieces are assembled, CONTRACTOR

shall remove rust preventive coatings from machined surfaces, thoroughly clean pipe ends and gaskets and carefully smooth all burrs and other defects. The flanged bolt holes on each end of flanged pipe and fittings shall accurately straddle the same horizontal and vertical centerlines, unless special drilling is required.

- C. Bolts should be tightened using proper bolt torques as recommended by the manufacturer. Threads must be clean and well lubricated and washers should be used to ensure correct torque. Bolts should be tightened alternatively and evenly.
- D. If a flange leak occurs and the bolts of the leaking side have been properly torqued, they should not be tightened further or permanent damage to the sealing face may result. Instead, the bolts on the opposite side should be loosened a half turn at a time and then the bolts on the leaking side should be tightened by the same amount. If the leak persists, the bolts should be removed and the sealing faces should be examined for scratches or dents across an entire face which could provide a leak path and appropriate measures taken such as polishing the flange face.

-- End of Section --

**SECTION 15240
TANKS**

PART 1 - GENERAL

1.01 SUMMARY

- A. The Contractor shall provide all equipment, materials and services for the supply and installation of the Backflush Holding Tank for installation in the groundwater treatment system.
- B. This section covers the requirements for the functional design, performance, construction features, testing, quality and handling of the equipment described in the following sections.

1.02 SYSTEM DESCRIPTION

- A. The Contractor shall provide all labor, materials, and equipment and accessories to install one (1) 12,000-gallon Backflush Holding Tank.

1.03 SUBMITTALS

- A. The Contractor shall submit, in the manner and within the time limit as set forth in the contract documents, shop drawings showing outline and overall dimensions, connection details, weights, anchorage details, arrangement of functional parts, and parts lists if applicable, for all equipment and materials furnished.
- B. The Contractor's drawings shall be direct reproducibles able to produce clear, sharp, and legible prints. Fabrication of the equipment shall not be started until after the Contractor has received written drawing review approvals from the ENGINEER.
- C. Review of the drawings by the ENGINEER shall not relieve the Contractor of the entire responsibility for the engineering, design, workmanship and material under the contract documents.
- D. Submittals
 - 1. Six (6) copies of shop drawings showing details of fabrication and erection of all materials and equipment.
 - 2. Manufacturer's detailed technical data for materials, fabrication and installation. Include catalog cuts of all equipment, hardware, anchors, fastenings and accessories.
 - 3. Six (6) copies of the operation and maintenance manual for the equipment provided.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. The CONTRACTOR shall supply and install tank as described herein and as shown in the Contract drawings.
- B. All piping associated with the tank, including overflow lines, shall be Schedule 40 Carbon Steel.

2.02 BACKFLUSH HOLDING TANK (T-1)

- A. The CONTRACTOR shall provide and install a Backflush Holding Tank constructed of carbon steel. The tank shall be a circular and flat bottomed with a nominal capacity of 12,000 gallons. The tank diameter shall be 14 feet. Flanged nozzles as listed below shall be provided.

Nozzle Name	Size	Quantity	Description	Elevation (above grade)
Trailer	4-inch	1	150 lb FF	0' - 8 15/16"
Drain	6-inch	1	150 lb FF	0' - 10"
Overflow	8-inch	1	150 lb FF	11' - 4"
Backflush	8-inch	1	150 lb FF	1' - 2 3/16"
Spare	4-inch	1	150 lb FF	3' - 0"
Fill	8-inch	2	150 lb FL-FL	11' - 0"

2.03 ACCESSORIES

- A. The CONTRACTOR shall provide peripheral base hold-down lugs on the tank and anchor to the concrete floor.
- B. The CONTRACTOR shall provide lifting lugs on the tank to provide for placement on site.
- C. The CONTRACTOR shall instruct the tank fabricator on the orientation, elevation and location of all connections per Contract Drawings to ensure efficient hydraulic profiles and pipe testings on site.
- D. The interior and exterior tank surfaces shall be shop finished and coated as specified herein. Surfaces shall be prepared and the coatings shall be applied in accordance with the instructions of the coating manufacturer.

2.10 FABRICATION/FINISHING

- A. Metal Tanks:
 - 1. Metal tanks, compartments, manways, and manway extensions shall be fabricated of ASTM A285 Grade C or A36 coated steel with all seams welded front and back. Surface

preparation shall be in strict accordance with coating manufacturer's recommendations for sand blasting, primer and final coat application. Tanks shall be painted in accordance with the attached Data Sheet.

2. Workmanship shall be first quality and all welding shall be in accordance with American Welding Society standards and in accordance with qualified welding procedures of the governing standards and include but are not limited to the following guidelines.
 - a. AWS-A2.0 - Structural Symbols
AWS-D1.1- Structural Welding
 - b. The edges of surfaces of the parts to be joined by welding shall be machined or thermal cut and cleaned of all oil, grease, scale, rust, or other deleterious material. Where thermal cutting is used, all loose scale must be removed. All remaining kerf material (that fused during the cutting process) and sharp cut surface cavities must be removed or blended by grinding or chipping to assure proper weld penetration.
 - c. Filler material to be used for joining must be analytically compatible with base metal; primary consideration shall be given to mechanical properties, corrosion resistance and welding response, as applicable for the particular application.
3. Nozzles and manways, as required, shall be attached by full penetration welds of both the wall and the reinforcing attachment. Welds which penetrate the full thickness of the nozzle neck or manway neck will not be accepted.
4. All nozzles, manways and internal components shall be accurately located both vertically and radially in accordance with the design drawing as provided by the Supplier to the nearest 1/4-inch.
5. All flange connections as required shall be flush trimmed with the inside surface of the vessel and finished, unless indicated otherwise on the drawings provided by the Supplier.

PART 3 - EXECUTION

3.01 ERECTION/INSTALLATION

- A. The equipment shall be installed in accordance with the requirements of the Contract documents and the manufacturer's instructions and recommendations.
- B. All work shall be performed by competent, trained workmen, skilled in the field to which they are executing the work.
- C. All equipment shall be properly and securely installed such that undue stresses are not exerted on equipment and connections.

3.02 TESTING AND INSPECTIONS

- A. Each system component shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of this specification and the intended use.
- B. The system shall be hydrostatically tests for leaks at the factory by filling with water. The system shall be checked for leaks after being filled for at least one hour.

3.03 WARRANTY

- A. Each tank shall be warranted against defects for a period of one (1) year from the date of installation.

- End of Section -

TANK DATA SHEET

Item No: T-1	Project No.: 02691	Spec. No.:
Description: Backflush Supply Tank	Project: Carbon Treat. Sys.	Location: Sauget, IL

See Drawing Number SS-1

1	Service: Treated Groundwater											
2	Shell Dia. (I.D.): 14'			Height: 12'								
3	Number Req'd: 1											
4			PRESSURE		TEMPERATURE		NOZZLES	Mark No.	Size (in.)	Qty	Facing	Rating
5	Operating		Atm.		70		Drain	A	6"	1	F.F.	150#
6	Design		Atm.		Ambient		Backflush	B	8"	1	F.F.	150#
7			MATERIAL		CORR. ALLOW.		Trailer	C	4"	1	F.F.	150#
8	Shell:		CS		None		Spare	D	4"	1	F.F.	150#
9	Roof:		N/A		N/A		Overflow	E	8"	1	F.F.	150#
10	Liner:		N/A				Fill	F	8"	2	FL-FL	150#
11	Type of Roof:		N/A		Uniform Load:		N/A					
12	Code: API-650 Appendix J											
13	Emergency Vacuum Design: N/A											
14	Liquid Ht:		10.5 ft		Sp. Gr.:		1.0		at		70 °F	
15	Insulation:		N		Type:							
16	Stress Relieve for Process Reasons:											
17	Min. design metal temperature:		5 F									
18	Steam out conditions:		psig @		°F							
19	Design Wind Speed:		70		mph							
20	Seismic Zone:		2A									
21	MECHANICAL (MATERIALS)											
22												
23												
24												
25												
26												
27	Applicable code:											
28	Construction:				Inspection:							
29	Stress Relieve:				Radiograph:							
30	Testing:											
31												

Remarks:

Tank Internal Coating/Liner:

Surface prep. According to SSPC-SP5
2 coats epoxy-polyamide 8-10 mil total DFT
(Tnemec 66 or equivalent)

Tank External Coating:

Surf. prep acc. to SSPC-SP6
Prime coat alkyd phenolic primer 2-3.5 mDFT
(Tnemec Series 37 or equivalent)
Top coat alkyd enamel, 2 coats at 1.5-3.5 mDFT per coat
Tnemec Series 2H or equivalent

Other Remarks:

PREPARED ON BEHALF OF Solutia, Inc.				Revision C	Date 7/23/03	Prepared By ATL
C	Contingency Plan			 The ADVENT Group, Inc.		
B	Pre-Final Design					
A	For Review					
ISSUE	DESCRIPTION	APP'D	CLIENT			
				 Solutia Inc. St. Louis, MO		

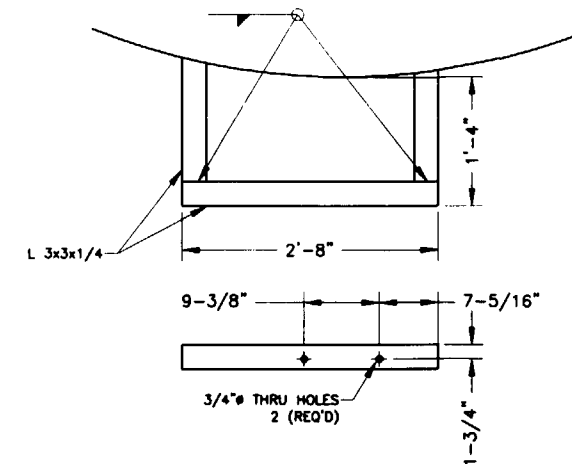
NOTES:

- 1" ANCHOR BOLT TO BE HAS STANDARD ASTM A36 STEEL ROD SECURED WITH HY150 ADHESIVE PER HILTI. MINIMUM EMBEDMENT OF BOLT IS 8 1/4" BELOW TOP OF CONCRETE.
- SITE WORK, SLAB, AND FOUNDATIONS TO BE DESIGNED BY OTHERS.

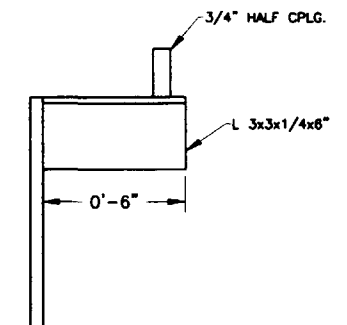
NOZZ.	QTY.	TYPE/ DESCRIPTION	ORIENT.	SERVICE
A	1	6" 150# FLG	-	DRAIN
B	1	8" 150# FLG	-	BACKFLUSH
C	1	4" 150# FLG	-	TRAILER
D	1	4" 150# FLG	-	SPARE
E	1	8" 150# FLG	-	OVERFLOW
F	2	8" 150# FLG/FLG	-	FILL
G	-	-	-	-

OVERALL DIMENSIONS (FT-INCH)						
HEIGHT	DA	C	D	E	F	G
12'-0"	14'-0"					

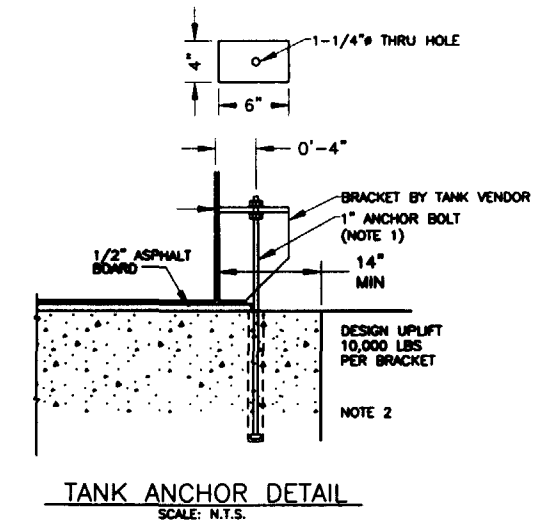
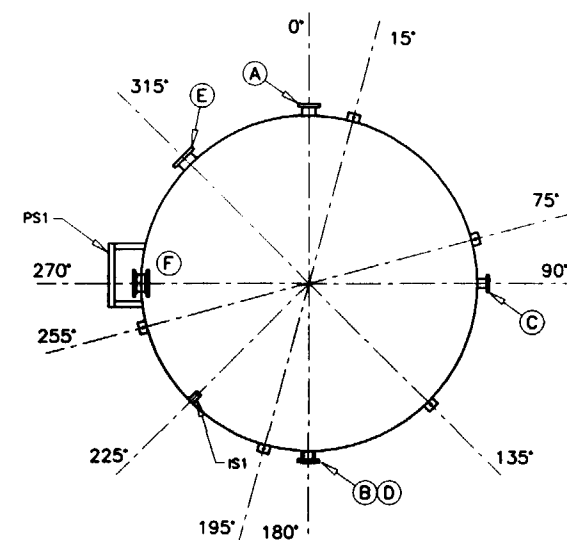
DESIGN PRESS. PSIG	AMB.	OP. PRESS. PSIG	ATM.
DESIGN TEMP. DEG F	AMB.	OP. TEMP. DEG F	70
LIQUID WATER PH.	7.0	SP. GRAVITY	1.0
DRY WT. LBS.	-	OP. WT. LBS.	-
TANK VOL. GAL.	12,000		
DESIGN CODE:	API 650, APPENDIX J		



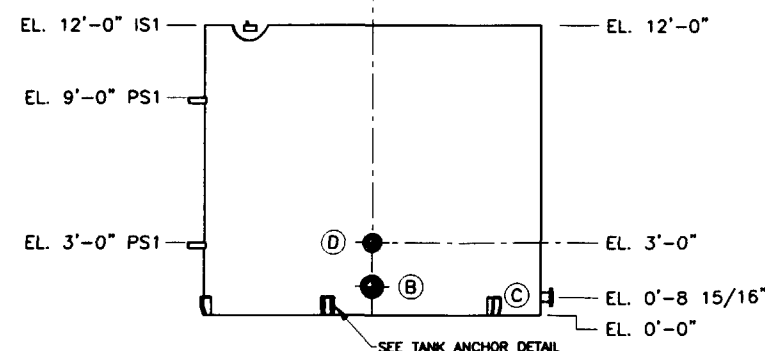
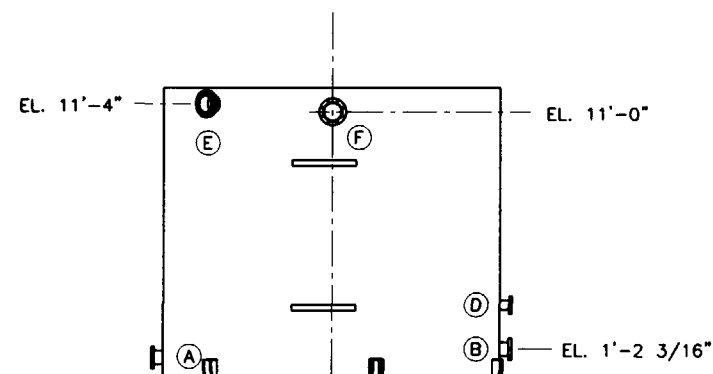
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PIPING SUPPORT
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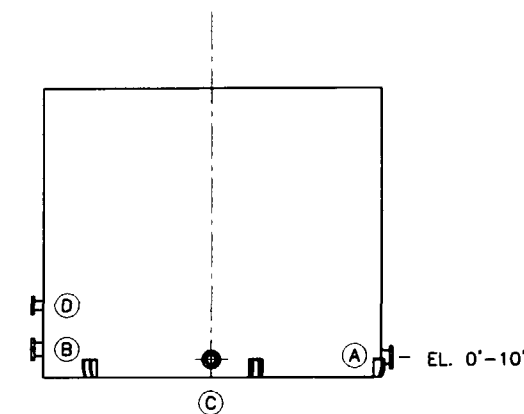
IS1
INSTRUMENT SUPPORT
SCALE: 3" = 1'-0"




TANK ANCHOR DETAIL
SCALE: N.T.S.



T-1
BACKFLUSH SUPPLY TANK

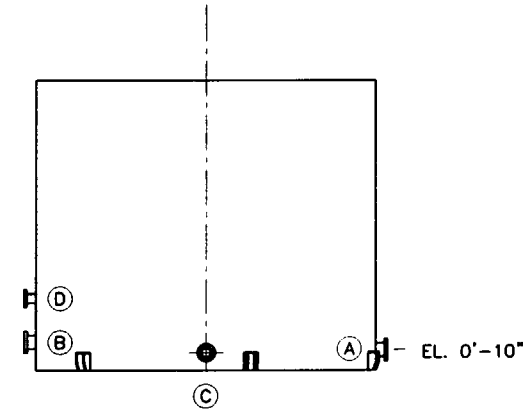
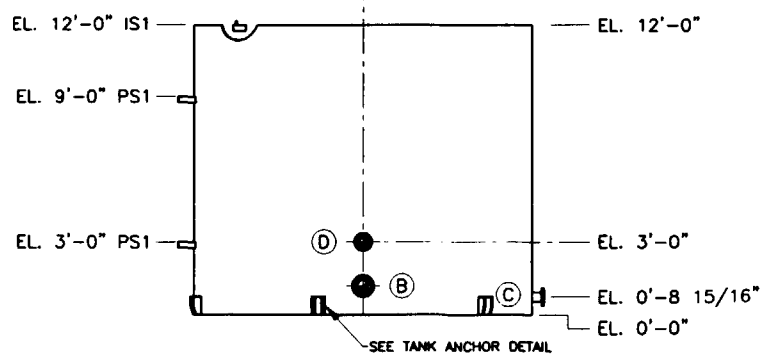
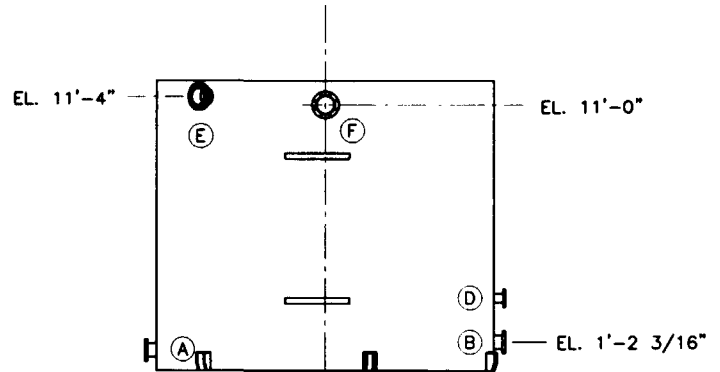
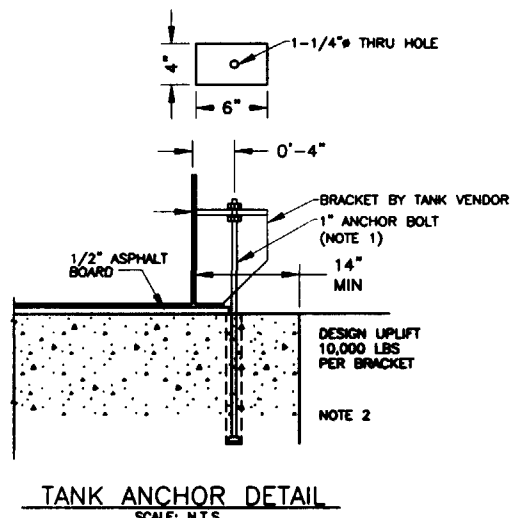
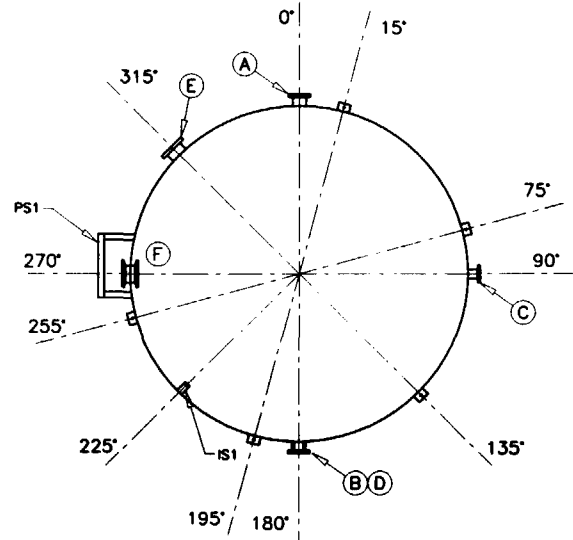
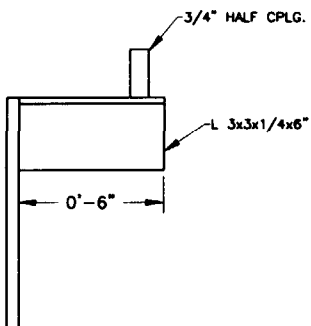
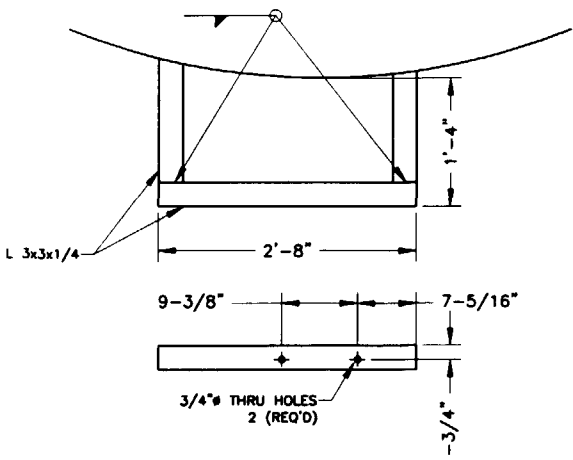


D	CONTINGENCY PLAN	7/23/03	CSR	RLR
C	PRE-FINAL DESIGN	11/19/02	CSR	RLR
REV	DESCRIPTION	DATE	APPR BY	MADE BY
REVISIONS				
 THE ADVENT GROUP, INC. Nashville, Tennessee				
BACKFLUSH SUPPLY TANK PLAN AND ELEVATION				
SOLUTIA KRUMMRICH SAUGET, IL				
BY	DATE	BY	DATE	
DRAWN RLR	11/14/02	APPR. CSR	11/14/02	
CHKD. TL	11/14/02			
SCALE: 1/4" = 1'-0"	SHEET 1 OF 1	SIZE: D		
FILE LOCATION: L:\DATA\02691\CAD\PIPING\PP-01_03-SS-01.DWG				
CONTRACT NO.	DRAWING NO.	REV.		
02691	SS-01	D		

NOTES:

1. 1" ANCHOR BOLT TO BE HAS STANDARD ASTMA36 STEEL ROD SECURED WITH HY150 ADHESIVE PER HILT.
MINIMUM EMBEDMENT OF BOLT IS 8 1/4" BELOW TOP OF CONCRETE.
2. SITE WORK, SLAB, AND FOUNDATIONS TO BE DESIGNED BY OTHERS.

NOZZ.	QTY.	TYPE/ DESCRIPTION	ORIENT.	SERVICE		
A	1	6" 150# FLG	-	DRAIN		
B	1	8" 150# FLG	-	BACKFLUSH		
C	1	4" 150# FLG	-	TRAILER		
D	1	4" 150# FLG	-	SPARE		
E	1	8" 150# FLG	-	OVERFLOW		
F	2	8" 150# FLG/FLG	-	FILL		
G	-	-	-	-		
OVERALL DIMENSIONS (FT-INCH)						
HEIGHT	DIA	C	D	E	F	G
12'-0"	14'-0"					
DESIGN PRESS. PSIG		AMB	OP. PRESS. PSIG		ATM.	
DESIGN TEMP. DEG F		AMB	OP. TEMP. DEG F		70	
LIQUID WATER PH.		7.0	SP. GRAVITY		1.0	
DRY WT. LBS.		-	OP. WT. LBS.		-	
TANK VOL. GAL		12,000				
DESIGN CODE:		API650, APPENDIX J				



T-1
BACKFLUSH SUPPLY TANK

D	CONTINGENCY PLAN	7/23/03	CSR	RLR
C	PRE-FINAL DESIGN	11/19/02	CSR	RLR
REV	DESCRIPTION	DATE	APPR BY	MADE BY
REVISIONS				
 THE ADVENT GROUP, INC. Nashville, Tennessee				
BACKFLUSH SUPPLY TANK PLAN AND ELEVATION				
SOLUTIA KRUMMRICH SAUGET, IL				
BY	DATE	BY	DATE	
DRAWN RLR	11/14/02	APPR. CSR	11/14/02	
CHKD. TL	11/14/02			
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FILE LOCATION: L:\DATA\02691\CAD\PIPING\PP-01_03-SS-01.DWG				
CONTRACT NO.	DRAWING NO.	REV.		
02691	SS-01	D		

**SECTION 15251
CARBON ADSORPTION SYSTEM**

PART 1 - GENERAL

1.01 SUMMARY

- A. The CONTRACTOR shall supply and provide all materials, fabrication, drawings, erection, design, installation, testing and delivery of services as specified in this section and/or on the drawings for completion and proper operation of the carbon adsorption system, as included in the contract documents.
- B. This section covers the requirements for the functional design, performance, materials, construction features, testing, quality and handling of the equipment described herein.
- C. It is not the intent of this section and associated drawings to specify all details of design, fabrication and construction. It shall be the responsibility of the CONTRACTOR to provide equipment that has been designed, fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service.

1.02 SYSTEM DESCRIPTION

- A. The carbon adsorption system shall be used to remove volatile and semi-volatile organic compounds. The carbon adsorbers will be designed and installed completely skid-mounted with all necessary isolation and diversion valves, controls, face piping and appurtenances. The carbon adsorption system shall consist of 4 (four) carbon adsorber skids with two (2) adsorbers per skid. Each vessel shall contain a minimum of 20,000 pounds of granular activated carbon. The system piping shall allow for the adsorber vessels to be used in series or in a lead/lag configuration.

1.03 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

Flow: 1000 gpm (max.)
Groundwater Temperature: 40-60°F

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Any reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired. In all cases, any comparable source or device is acceptable upon approval by the ENGINEER.
- B. Equipment described under this section shall be furnished by manufacturers who are experienced, reputable and qualified in the manufacture of carbon adsorption systems. The manufacturer shall be fully responsible for the proper operation and performance of the system as a whole.

- C. The carbon adsorption system shall include: Four (4) liquid phase activated carbon adsorber skids with 2 adsorbers per skid, all necessary valves, controls, face piping, and appurtenances. Each vessel shall be capable of filtering up to 470 gpm.
- D. Provide carbon adsorbers containing reactivated granular activated carbon manufactured from metallurgical grade bituminous coal meeting or exceeding the carbon requirements of Calgon DSR-C 8x30 or equal listed below.

Iodine No. (minimum mg/g)	800
Screen Analysis:	
-under 30 mesh (maximum %)	5
Water Soluble Ash (maximum %)	9
Moisture, as packed (maximum %)	2
Apparent Density (maximum g/cc)	0.60

2.02 ADSORBER VESSELS

- A. Each adsorber vessel shall be lined carbon steel and have a minimum straight side height of 8 feet for holding 20,000 pounds of activated carbon. Vessel diameter shall be 10 feet.
- B. The adsorbers shall be designed for a working pressure of 75 psig and a test pressure of 1.5 times the working pressure.
- C. The adsorbers shall be designed for a working temperature of 50°F and a maximum temperature of 150°F.

2.03 PIPING/PIPE RACK

- A. The process and utility piping on the adsorption system shall include influent water to the system, treated water (effluent), adsorber vent lines and carbon fill and discharge piping. The influent and effluent piping shall be installed such that the adsorbers can be operated in series. The connections to the carbon vessels shall be "quick connect" hose connections.
- B. Effluent piping shall be flexible hose to carbon steel.

2.04 PRESSURE RELIEF

- A. A pressure relief valve shall be provided for each vessel, with relief capacity as required by ASME Code and hydraulic system analysis. Relief venting shall be integral to adsorption system piping and directed as shown in the contract drawings.

2.05 PRESSURE GAUGES

- A. The process piping shall be equipped with pressure gauges to indicate the pressure of water entering and exiting each adsorber to provide information on pressure drops across each adsorber and the system. The gauge shall read 0-50 psig with an accuracy of 1 % of full range.

2.06 STRUCTURAL STEEL SUPPORT SKID

- A. All equipment items comprising the adsorption system shall be contained on structural steel skids. The skid shall be carbon steel
- B. The structural skids shall be supported as shown on the contract documents such that the skid is elevated a minimum of 18 inches above the finished grade of the pad to accommodate draining.
- C. All structural steel shall be cleaned to a power tool grade (mechanical grade) and a rust inhibitive alkyd metal primer shall be applied before any rust can form. A finish exterior painting of an alkyd resin-based paint for outside service must be applied to the exterior of the piping before rust can form beneath the primer coat. All equipment items shall be installed on the structural steel skid and secured for shipment. Field connections shall be clearly noted, with any extra materials secured to, and shipped with the skid system.

PART 3 - EXECUTION

3.01 ERECTION/INSTALLATION

- A. Installation procedures shall be in accordance with the recommendations of the manufacturers of the carbon vessels. Installation of the carbon vessels will not be allowed to proceed until the recommendations are received and approved by the ENGINEER.

3.02 TESTING AND INSPECTIONS

- A. Equipment Testing
 - 1. Notify the ENGINEER five (5) working days prior to conducting any tests listed in the Specification, to permit the ENGINEER to witness said tests. Witness of any test shall not be deemed acceptance of the component or system tests, nor waive any on site acceptance thereof.
 - 2. All non-destructive testing examinations shall be performed in accordance with the ASME, ANSI or ASTM codes. The cost of repair and/or any additional non-destructive testing shall be borne by the CONTRACTOR. The CONTRACTOR shall submit his/her test procedures to the ENGINEER for approval.
 - 3. Prior to final inspection, the inside and outside of all vessels, piping and instruments shall be cleaned of slag, loose scale, dirt, grit, weld splatter, pieces of metal, oil, etc.

B. System Acceptance Test

All equipment and systems affiliated with the granular carbon adsorption system such as pumps, filters, etc. shall be checked out according to the manufacturer's instructions. Specific activities to complete before operating the adsorption equipment shall include the following:

1. Check all piping connections for proper installation and tightness.
2. Ensure that all gauges and instruments are functional and installed correctly. Re-zero or re-calibrate if necessary.
3. Close all valves in the adsorber piping system.
4. Install the carbon acceptance canister (if provided) after checking to ensure it is filled with carbon.

3.03 WARRANTY

- A.** Equipment shall be warranted against manufacturer defects for a period of one (1) year from the date of installation.

-- End of Section --

CARBON COLUMN DATA SPECIFICATION SHEET

Item No:	V-1A/B through V-4A/B	Project No.:	02691	Spec. No.:	
Description:	Carbon Treatment System	Project:	Carbon Trt. Sys.	Location:	Sauget, IL

GENERAL



The Activated Carbon Adsorption System will be designed for the removal of soluble organic chemical contaminants. The unit will be a complete water treatment system and be provided with piping for parallel or series operation. The unit will come equipped with piping sections and manual valves for influent and treated water, carbon transfer, and venting operations.

The units will be skid-mounted and be configured to give a working height of less than 16 feet.

SPECIFICATIONS

Qty.:	4 dual trains (1 lead, 1 lag column ea.) with ea. train operating in series		
Vessel Diameter:	10 ft		
Heads:	2:1 Elliptical		
ASME Code:	Up to 75 psig @ 150 deg. F		
Pipe Connections:	Std ANSI flanged connections (see nozzle schedule)		
Carbon Volume:	715 cu ft		
Weight (per dual train):	Empty - 57,000 lb	/	Operating - 330,000 lb
Backflush Rate: (per column)	225 gpm		
Transfer Mode:	Air pressurized slurry transfer by supply truck		
Operation Modes:	Downflow fixed bed with backflush capabilities Parallel or series flow		
Max Flow: (per column)	470 gpm	Avg. Flow: (per column)	200 gpm
Process Conditions			
TSS:	< 15 mg/L		
TOC:	300 mg/L		
Materials of Construction	Vessel:	Carbon Steel (ASTM A-36)	
	Vessel Lining:	Vinyl Ester coating (nominal 40 mil)	
	Piping and Valves:	Carbon steel piping (std. wt. ASTM A-53), ductile iron butterfly valves with stainless steel disc for process piping and stainless steel ball valves for carbon transfer	
	Underdrain Collection System:	Internal ring underdrain or equivalent to ensure equal flow distribution.	
	External Coating:	Surf. prep acc. to SSPC-SP6; Prime coat alkyd phenolic primer 2-3.5 mDFT Top coat alkyd enamel, 2 coats at 1.5-3.5 mDFT per coat (Primer - Tnemec series 37, Top coat - Tnemec series 2H or equivalents)	
Pressure Relief	Graphite rupture disk or equivalent, 75 psig burst pressure (1 per column).		
Instrumentation / Control System	All process valves will be operated manually.		

(Continued Next Page)

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C	Contingency Plan			 The ADVENT Group, Inc.		 Solutia, Inc. St. Louis, MO			
B	Pre-Final Design								
A	For Review								
ISSUE	DESCRIPTION	APP'D	CLIENT						

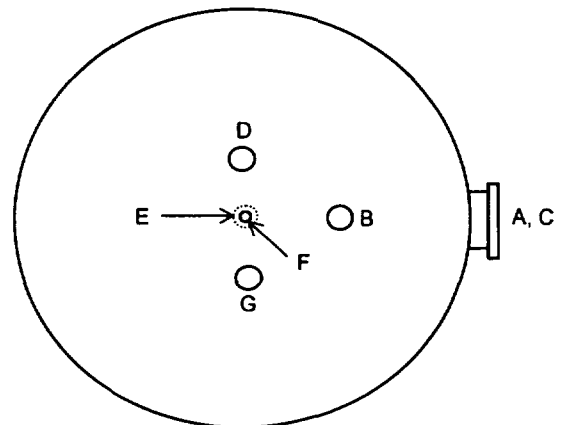
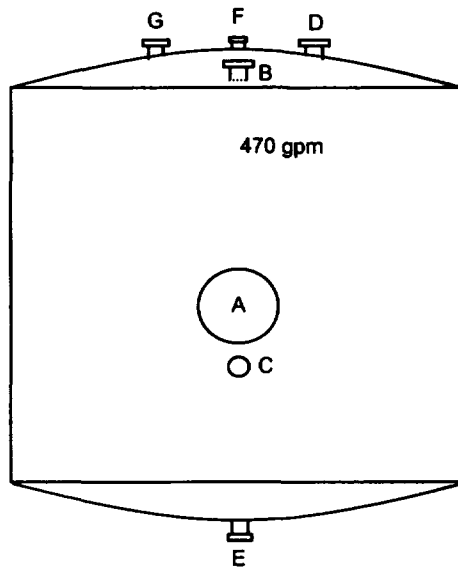
CARBON COLUMN DATA SPECIFICATION SHEET



Item No:	V-1A/B through V-4A/B	Project No.:	02691	Spec. No.:	
Description:	Carbon Treatment System	Project:	Carbon Trt. Sys.	Location:	Sauget, IL

NOZZLE SCHEDULE

#	Location	Size	Flange Type
A	Side Manway	20"	F.F.
B	Process In	4"	150# F.F.
C	Process Out/BF In	4"	150# F.F.
D	Carbon In	4"	150# F.F.
E	Carbon Out	4"	150# F.F.
F	Spray Water	3"	150# F.F.
G	Vent/BF Out	4"	150# F.F.

Note: Nozzle locations shown are for Vessel 1.
Vessel 2 nozzle locations will be mirror image.



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**SECTION 15260
AIR COMPRESSOR**

PART 1 - GENERAL

1.01 SUMMARY

- A. The CONTRACTOR shall supply and provide all materials, fabrication, drawings, erection, design, testing and delivery of services as specified in this section and/or on the drawings for completion and proper operation of the air compressor system, as included in the contract documents.
- B. This section covers the requirements for the functional design, performance, materials, construction features, testing, quality and handling of the equipment described herein.
- C. It is not the intent of this section and associated drawings to specify all details of design, fabrication and construction. It shall be the responsibility of the CONTRACTOR to provide equipment that has been designed, fabricated and equipped in accordance with stated standards and high standards of engineering and workmanship that is suitable for the specified service.

1.02 SYSTEM DESCRIPTION

- A. The air compressor system comprises of the air compressor system required to provide air for carbon transfer as shown on the contract drawings. The CONTRACTOR shall procure a compressor adequately sized to accommodate the transfer of carbon slurry to and from trailers to carbon columns on site.

1.03 PERFORMANCE REQUIREMENTS AND DESIGN CRITERIA

- A. The air compressor shall be sized for 40 ACFM at 100 psig to provide compressed air for reliable service to transfer carbon from trailers to carbon vessels and vise versa.

1.04 SUBMITTALS

- A. The CONTRACTOR shall submit, in the manner and within the time limit as set forth in the contract documents, shop drawings showing outline and over all dimensions, connection details, weights, anchorage details, arrangement of functional parts, and parts lists if applicable, for all equipment and materials furnished.
- B. The CONTRACTOR's drawings shall be direct reproducibles able to produce clear, sharp and legible prints. Fabrication of the equipment shall not be started until after the CONTRACTOR has received written drawing review approvals from the ENGINEER.
- C. Review of the drawings by the ENGINEER shall not relieve the CONTRACTOR of the entire responsibility for the engineering, design, workmanship and material under the contract documents.

D. Submittals

1. Six (6) copies of shop drawings showing details of fabrication and erection of all materials and equipment.
2. Manufacturer's detailed technical data for materials, fabrication and installation. Include catalog cuts of all equipment, hardware, anchors, fastenings and accessories. At a minimum the following data for the compressed air supply equipment shall be furnished; manufacturer, model, bore and stroke of compressors, R.P.M. capacity, H.P. required at rated capacity and pressure, total weight.
3. Six (6) copies of the operation and maintenance manual for the equipment provided.
4. Six (6) copies of the installation instructions shall be furnished to the ENGINEER. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc, that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.05 APPLICABLE CODES AND REFERENCES

- A. NEPA- National Electrical Code
- B. ASME - Boiler and Pressure Vessel Code

1.06 PERFORMANCE GUARANTEES AND WARRANTY

- A. CONTRACTOR shall provide a one (1) year warranty.
- B. Air Compressor shall be rated for the flow rate of 40 acfm at 100 psig minimum.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Any reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired and is not to be considered proprietary. In all cases, any comparable source or device is acceptable upon approval by the ENGINEER.
- B. Equipment described under this section shall be furnished by manufacturers who are experienced, reputable and qualified in the manufacture of air compressors. The manufacturer shall be fully responsible for the proper operation and performance of the system as a whole.

2.02 AIR COMPRESSOR

Provided a skid mounted, electric motor driven, air cooled, outdoor weather protection, freeze protection, prewired and prepiped, completely packaged, rotary screw lubricated air compressors. Provide one air receiver, and oil/water separator, also skid mounted. Each compressor shall supply compressed air at 100 psig continuously. All controls shall be suitable for wet locations.

A. Scope:

This section specifies the Air Compressor and related components.

The subcontractor shall assign unit responsibility to the air compressor manufacturer for the combined equipment consisting of the air compressor and associated appurtenances specified herein.

B. Operating Requirements:

Air compressors and accessories shall be designed and selected for continuous duty operation and shall deliver clean, oil-filtered air. Compressors shall at all times deliver air which meets the operating requirements listed in this section. Inlet air shall be filtered with a medium efficiency filter before distribution as specified herein.

1.	Discharge pressure, psig	100
2.	Capacity at rated discharge pressure, acfm	40
3.	Installed motor horsepower, maximum	15

C. Manufacturers:

Air compressors shall be manufactured by one of the following:

Atlas Copco Model No. GA-7, or equal

E. Equipment:

1. General:

The air compressor shall be the lubricated, single stage, air-cooled and cabinet enclosed, rotary screw type. The units shall be capable of continuous operation without thermal damage. The compressor is to be skid mounted and shall contain, but not be limited to the following:

- Belt drive with automatic tensioning device
- Hi-Efficiency TEFC electric motors (460V/3 Phase/60 Hz)

- NEMA 4 starters
- Oil filter, air/oil separator and oil reservoir

The motor shall be specifically designed for the torque, speed, and horsepower characteristics of the compressor. The motor shall operate using 460V, three phase, 60Hz power.

2.03 LUBRICANT

- A. Lubricant used shall contain no chemical substances that would require disposal as a hazardous waste according to applicable regulations at the time of sale. Used lubricant shall be suitable for recycling.
- B. Lubricant carryover into the downstream system shall not exceed 3 ppm by weight.

2.04 OIL SEPARATOR

The oil separator shall contain two oil collection containers, an oil prefilter, an activated carbon filter, a sample line assembly, an inlet hose assembly and a test kit including reference jar and sample jar. The oil separator system shall be designed such that separator elements can be changed without disturbing the discharge air line.

2.05 COMPRESSED AIR RECEIVER

Provide steel receiver constructed and labeled in accordance with the ASME Boiler and Pressure Vessel Code for not less than 120 gallons and 120 psig service. Provide a pressure gauge, a pressure relief (safety) valve, a service valve (3/4" ball), and receiver drain valve. Set pressure relief valve at 125 psig.

2.06 ENCLOSURE

Outdoor weather protection shall be provided to protect the compressor from weather and freezing.

2.07 COMPRESSED AIR PIPING

- A. System Description:

Provide new air piping system, complete and ready for operation. Piping systems including manufacturer's products shall be in accordance with the required and advisory provisions of the Plumbing Code (NAPHCC NSPC).

- B. Products - Pipes, Fittings, etc.

All piping and valving to be rated for 150 psig ambient.

2.11 INSTRUMENTATION AND CONTROLS

All controls for the system shall be suitable for wet locations.

Compressors shall be provided with a control panel. Provide a main disconnect switch with the handle accessible from outside the control panel door. The control panel shall have a NEMA 4 enclosure. The control panel shall be provided with a NEMA-rated motor starter for each compressor. The control panel shall be provided with an alarm light for each shutdown condition. A reset pushbutton shall be provided for cancellation of alarms.

Alarm lights, reset pushbutton, and other operator controls shall be located on the front of the panel door. The compressor shall be provided with a run-time meter and a HAND-OFF-AUTO switch (with a spring return to "OFF" from the "HAND" position) on the panel door.

Compressor controls shall monitor external a pressure switch mounted on the receiving tank. The pressure relief safety valve will unseat at 125 psi. High discharge air temperature shall shut down the faulted compressor and activate an alarm light. Alarm light shall remain illuminated until alarm condition has been rectified and reset pushbutton has been depressed.

Compressed air system shall have at least the following indicators: Inlet air pressure gauge, discharge air pressure gauge, inlet air temperature gauge, temperature gauge, inlet and outlet pressure gauges, green "power on" light, power interruption light, and the high temperature light.

2.12 ELECTRICAL REQUIREMENTS

The Subcontractor is responsible for all electrical wiring of the Compressed Air System up to and including Control Panel.

Control Panel shall be UL listed or CSA approved and shall be wired for 460 VAC, 3-phase, 4-wire, power service.

Electrical installations shall conform to ANSI C2, NFPA 70, IEEE 100 and other specified standards.

PART 3 - EXECUTION

3.01 ERECTION/INSTALLATION

- A. Erection of the compressor, receiver, and appurtenances shall be by an authorized representative of the manufacturer in strict accordance with the manufacturer's recommendations and instructions in the location as shown on the drawings. Erection shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

- B. The CONTRACTOR shall require the factory representative to check over the complete air compressor installation and start-up testing to the satisfaction of the ENGINEER.
- C. Anchor bolts of Type 304 stainless steel shall be furnished by the equipment manufacturer and set by the CONTRACTOR in accordance with the manufacturer's recommendations and setting drawings. Provisions for vibration isolation shall be included during installation.
- D. Equipment shall be provided with manufacturer's standard prime and finish paint. Paint shall be capable of withstanding heat build-up generated by operating equipment without blistering, delaminating or other forms of failure.

3.02 TESTING AND INSPECTIONS

- A. Each system component shall be given requisite factory tests as necessary to determine that the work and materials are free from defects and to establish that the design and construction meet the requirements of the contract documents.
- B. Vibration tests shall be conducted by the factory representative to insure that there is not harmful vibration in either compressor or in the system piping.

3.03 WARRANTY

- A. Equipment shall be warranted against defects for a period of one (1) year from the date of installation.

- End of Section -

AIR COMPRESSOR



Item No:	C-1	Project No.:	02691	Spec. No.:	
Description:	Carbon Transfer Air	Project:	Carbon Trt. Sys.	Location:	Sauget, IL

GENERAL

The air compressor shall be of a single stage, 40 CFM minimum, 100 psig, oil injected, air cooled, screw type. All components will be provide as a package unit with a sound enclosure and outside weather protection. The package will include an oil injected air cooled, screw type, compressor, drive motor, oil lubricating system, air system, and minimum 120 gallon ASME coded air receiver. All electronic regulating controls shall be provided.

COMPONENTS

Compressor	The compressor element shall be a rotary screw design consisting of asymmetrical rotor profile for minimal internal leakage and maximum compressor efficiency. Heavy duty bearings capable of L-10 bearing life in excess of 90,000 hrs shall be used.
Drive Motor	Shall be TEFC NEMA or IEC T frame, squirrel cage, induction type with Class F insulation. Motor to be 3 ph, 60 Hertz, 460 Volt. Motor construction shall be rugged cast frame, cast rotor, non-hygroscopic insulation, phase corrosion resistant wire, premium efficiency. Motor service factor shall be 1.15.
Oil System / Aftercooler	Lubrication shall be accomplished by inherent pressure differentials and without the use of an external mechanical oil pump. A heavy duty, full flow 10 micron oil filter and oil aftercooler shall be provided with an OSHA approved fan guard. The aftercooler, moisture separator and automatic condensate trap are to be piped and mounted within the compressor package.
Air System	The air system shall consist of a dry-type air intake filter rated at 3 microns, pneumatically operated air intake valve /
Controls	<p>A solid state electronic control system shall be provided including:</p> <ul style="list-style-type: none"> • Constant run control (load / no load) • Automatic start / stop control • Drive motor overload indicator with shutdown • Dual / Independent high temperature indicator with shutdown • Air filter change indicator • Digital readouts for compressor discharge air pressure and air temperature, reservoir discharge pressure • Stop / reset indicator • Mounted and wired starter • Moisture sensor status • Oil separator change indicator

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SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Lighting, including lamps.
- B. Wiring devices.
- C. Wiring for built-in and Owner furnished equipment.

1.02 RELATED WORK SPECIFIED UNDER OTHER DIVISIONS

- A. Field painting, except such painting as is required to maintain shop coat painting and factory finish painting.
- B. Cutting and patching for electrical work, except for errors and omissions under this Division.

1.03 QUALITY ASSURANCE

- A. Comply with applicable local, state, and federal codes.
- B. Warrant electrical Work against faulty material or Workmanship in accordance with Division 1. If the Project is occupied or the systems placed in operation in several phases at the request of the Owner's Representative, then the warranty of each system or piece of equipment used, shall begin on the date each system or piece of equipment was placed in satisfactory operation and accepted as such, in writing, by the Owner's Representative. The use of building equipment for temporary service and testing does not constitute the beginning of the warranty.
- C. Equipment and material provided under this Division shall be periodically inspected and serviced by competent mechanics. This function becomes the responsibility of the Owner's Representative when the system is accepted by the Owner's Representative. The one year material and Workmanship warranty is not intended to supplant normal inspection or service and shall not be construed to mean the Contractor shall provide free service for normal maintenance items such as periodic lubrication and adjustment due to normal use, nor to correct without charge, breakage, maladjustment, and other trouble caused by improper maintenance.
- D. Turn over electrical equipment provided under this Division to the Owner's Representative in lubricated condition. Include instructions on further lubrication in the operating manual.

- E. Upon completion of contract and progressively as work proceeds, clean-up and remove dirt, debris and scrap materials. Maintain premises neat and clean. Protect and preserve access to energized equipment at all times. Clean items with factory finishes. Touch-up minor damage to surfaces; refinish entire piece of equipment when sustained major damage. Use only factory supplied paints of matching color and formula.

1.04 STANDARDS

- A. Perform Work specified in Division 16 in accordance with standards listed below. Where these Specifications are more stringent, they shall take precedence. In case of conflict, obtain a decision from the Engineer.
 - 1. NFPA-70: National Electrical Code.
 - 2. NFPA-101: Life Safety Code.
 - 3. ANSI Handicapped Code-A117.1.
 - 4. SBC: Standard Building Code.

1.05 SUBMITTALS

- A. Comply with provisions of Division 1.
- B. Submit shop Drawings as called for in the Sections that follow.

1.06 OPERATING AND MAINTENANCE MANUALS

- A. Provide manuals in accordance with Division 1.

1.07 DELIVERY AND STORAGE

- A. Insofar as possible, deliver items in manufacturer's original unopened packaging. Where this is not practical, cover items with protective materials to keep them from being damaged. Use care in loading, transporting, unloading, and storage to keep items from being damaged.
- B. Store items in a clean dry place and protect from damage.
- C. Store away from corrosive elements.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Equipment and materials furnished shall be listed by UL or other nationally accredited testing laboratory where available. When listing is not available for a piece of equipment, it will be accepted provided it is furnished in accordance with Drawings and Specifications and is approved by the authorities having jurisdiction.

- B. Specifications and Drawings indicate name, type and/or catalog number of materials and equipment to establish standards of quality. Submittals shall be based on standards specified. The standards should not be construed as limiting competition.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Visit site and observe conditions under which Work must be performed. No subsequent allowance will be made because of error or failure to obtain necessary information to completely estimate and perform Work required by these documents.
- B. Examine Specifications and Drawings to be familiar with items which require electrical connections and coordination. Electrical Drawings are diagrammatic and shall not be scaled for exact sizes.
- C. Equipment shall be installed in accordance with manufacturer's recommendation. Where conflicts occur between Contract Documents and these recommendations, a ruling shall be requested before proceeding with such work.

3.02 CUTTING AND PATCHING

- A. Repair or replace routine damage caused by cutting performance of Work under this Division.
- B. Correct unnecessary damage caused due to installation of electrical Work, brought about through carelessness or lack of coordination.
- C. Holes cut through floor slabs shall be core drilled with drill designed for this purpose. All openings, sleeves, and holes in slabs between floors shall be properly sealed, fire proofed and water proofed.
- D. Electronic equipment or devices that have been inundate or exposed to moisture or corrosive elements shall be replaced in their entirety.

3.03 TRENCHING, EXCAVATION, BACKFILLING, AND REPAIRS

- A. Provide trenching, excavation, and backfilling necessary for performance of Work under this Division.
- B. Provide sheathing, shoring, dewatering, and cleaning necessary to keep trenches and their grades in proper condition for Work to be carried on.
- C. Trenching and excavation shall be unclassified. No extra will be paid in the event that rock is encountered.

3.04 TESTS

- A. On completion of Work, installation shall be completely operational and entirely free from grounds, short circuits, and open circuits. Perform operational tests as required to demonstrate substantial completion of the Work. Balance circuits so that feeders to panels are not more than 10% out of balance between phases with all available load energized and operating. Furnish all labor, materials and instruments for above tests.

3.06 INSPECTION FEES AND PERMITS

- A. Obtain and pay for all necessary permits and inspection fees required for electrical installation.

END OF SECTION

SECTION 16110

RACEWAYS AND CONDUIT SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Sections 16010.
- B. Provide a complete conduit system with associated couplings, connectors, and fittings.

1.02 SUBMITTALS

- A. Submittal of products furnished under this Section are not required.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. IMC and Rigid conduit shall be hot dipped, galvanized, or electro galvanized steel by Allied, General Electric, Republic, Triangle, or Wheatland.
- B. PVC conduit shall be Carlon, Schedule 40 or Schedule 80, 90 degrees C. rated.
- C. Surface metal raceways shall be Wiremold.
- D. Associated couplings, connectors and fittings shall be steel as manufactured by Raco or equivalent.
- E. Erickson couplings shall be used where neither length of conduit can be rotated.
- F. Conduit, connectors, couplings and fittings shall be UL listed and labeled.

2.03 OUTSIDE AREAS

- A. Intermediate Metal Conduit (IMC)
 - 1. Use Intermediate Metal Conduit (IMC) where drawings call for conduit to be:
 - a. Installed for feeders.
 - b. Installed exposed below 6 feet.
 - c. Installed in wet locations.
- B. Polyvinyl Chloride (PVC)
 - 1. Use PVC for:
 - a. Underground service entrance conduits for power.
 - b. Exterior branch circuits installed underground.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Minimum size of conduits shall be 3/4"**
- B. Conduit joints shall be cut square, threaded, reamed smooth, and drawn up tight so conduit ends will butt in couplings, connectors and fittings.**
- C. Make bends or offsets with standard ells or field bends with an approved bender.**
- D. Run concealed conduits in direct line with long sweep bends or offsets. Run exposed conduits parallel to and at right angles to building lines. Group multiple conduit runs in banks.**
- E. Secure conduits to boxes and cabinets with double locknuts and bushings.**
- F. Cap ends of conduits to prevent entrance of water and other foreign material during construction.**
- G. Complete conduit systems before pulling conductors.**
- H. Support conduits as specified in 16190 and in accordance with National Electrical Code.**
- I. Provide cable supports in conduits rising vertically in accordance with the National Electrical Code, Article 300.**
- J. Provide No. 12 AWG copper pull wires or nylon cord in all empty conduits. Provide insulated bushing on both ends of empty conduits.**
- K. Where IMC or RSC conduit is installed in a cabinet, junction box, pull box or auxiliary gutter, conductors shall be protected by insulated bushings. Locknuts shall be installed on conduit outside and inside enclosure.**
- L. In concrete slabs block up conduit from forms and securely fasten in place. Conduits in ground floor slabs shall have a minimum of 1-1/2" concrete coverage above and below. Stuff boxes and cork fittings to prevent entrance of water.**
- M. Terminate conduits for feeders and branch circuits directly into panelboard enclosure without the use of pull boxes, junction boxes, wire ways, or auxiliary gutters, unless the panelboard enclosure does not provide sufficient surface area for all conduits. Where such cases exist, notify the Architect. In no case shall splices in such boxes and wire ways be permitted.**
- N. Conduits shall be mechanically and electrically continuous from outlet to outlet and from outlets to cabinets, pull or junction boxes.**

3.02 PVC

- A. Provide 1/4" nylon pull rope in all primary power and incoming telephone service entrance conduits.**
- B. No PVC shall emerge from the ground or the concrete slab or encasement. PVC shall convert to galvanized rigid metal prior to penetrating slab or exiting concrete encasement.**
- C. Make bends with standard ells or with an approved bender. A blow torch shall not be used.**

END OF SECTION

SECTION 16121

CONDUCTORS - 600 VOLTS AND BELOW

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Sections 16010.
- B. Provide a complete system of conductors for lighting, power, and systems throughout the project.

1.02 SUBMITTALS

- A. Submit data sheets for products furnished under this Section.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Anaconda
- B. General Cable.
- C. Okonite.
- D. Triangle
- E. Rome.
- F. Southwire.

2.02 POWER CONDUCTORS

- A. Provide 98% conductivity copper conductors with 600-volt insulation.
- B. For conductors No. 12 AWG and No. 10 AWG, provide solid type THWN or THHN.
- C. For conductors No. 8 AWG and larger, provide stranded type THHN, or THWN applied consistently with insulation ratings and NEC requirements.
- D. Provide white or gray colored neutral conductors; provide color coded phase conductors.
- E. Minimum conductor size shall be:
 - 1. #12 for power wiring

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Conductors shall be continuous from origin to panel or equipment termination without splices. Where splices and taps are necessary or required, they shall be made in splice boxes.
- B. Install pull boxes in circuits or feeders over 100' long.
- C. Make splices and connections only in outlet, pull or junction boxes.
- D. Use powdered soapstone or pulling compound to pull conductors.
- E. Deliver conductors to jobsite new and in original wrapping, package or reel.
- F. Conductors and connections shall test free of grounds, shorts, and opens.
- G. Use Ideal wire nuts, Scotchlok Type Y, R, G, or B connectors for fixture connections at outlet boxes.
- H. Make feeder taps and joints with approved compression sleeves. Insulate sleeves with heat shrink tubing, rated 600 V., 90 degrees C., containing factory applied sealant.
- I. Leave a minimum of 8" slack wire in every outlet box whether it be in use or left for future use.
- J. Color code conductors as follows:
 - 1. 120/208 Volt Systems:
 - a. Phase A-Black
 - b. Phase B-Red
 - c. Phase C-Blue
 - d. Neutral-White
 - e. Ground-Green
 - 2. 277/480 Volt Systems:
 - a. Phase A-Brown
 - b. Phase B-Orange
 - c. Phase C-Yellow
 - d. Neutral-Gray
 - e. Ground-Green
- K. Use factory color coded conductors where commercially available. If not available, use black conductors and band with color tape.
- L. Install in each branch-circuit panelboard a legend explaining color code for ungrounded conductors.

- N. Complete conduit system, including bushings, before pulling wire and cable.
- O. Maintain separation of electric light, power, Class 1, 2 and 3 wiring throughout raceway systems. Comply with requirements of NFPA-70, paragraphs 300-3, 725-15 and 725-54.
- P. Clamp cables/conductors over 20 feet on vertical runs to reduce tensile loading due to the cables/conductors own weight.
- Q. Spare conductors shall be identified as spare and terminated with approved connectors.
- R. Conductors installed in underground duct banks shall not come into contact with dirt, grit, grease, sand, rock, or debris while being installed in conduit. Protect conductors by the use of heavy, clean drop cloth between ground surface and conductor. Clean conductors prior to application of pulling lubricants.

END OF SECTION

SECTION 16130
OUTLET BOXES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Section 16010.
- B. Provide each fixture, switch, receptacle, and other wiring device with a galvanized outlet box of appropriate size and depth for its particular location and use.

1.02 RELATED WORK

- A. Sections 16110: Raceways and Conduit Systems.
- B. Section 16190: Supporting Devices and Hangers.

1.03 SUBMITTALS

- A. Submittal of products furnished under this Section is not required.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. National
- B. Appleton.
- C. Racor.
- D. General Electric.
- E. Steel City.
- F. Carlon

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Locate boxes to prevent moisture from entering or accumulating within them.
- B. Support outlet boxes independently of conduit, as required by the National Electrical Code.

- C. Provide condulets with threaded hubs for screw connections and with the proper configurations for all changes of direction of exposed conduits. Standard conduit ells may be used if they do not interfere, damage, or mar the appearance of the installation.
- D. Use boxes of sufficient cubic capacity to accommodate the number of conductors to be installed. See Article 370 of the National Electric Code.
- E. Effectively close unused openings in boxes with metal plugs or plates.
- F. Secure boxes to surfaces upon which they are mounted or embed boxes in concrete masonry. Support boxes from structural members with approved braces.
- G. Provide bushings in holes through which cords or conductors pass.
- H. Install boxes so that the covers will be accessible at all times.
- I. Provide only corrosion resistant outlet boxes equivalent to Carlon's FD series of deep boxes.

END OF SECTION

SECTION 16131

PULL AND JUNCTION BOXES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Sections 16010.
- B. Provide pull and junction boxes of appropriate size and depth as indicated on the drawings and as specified hereinafter.

1.02 RELATED WORK

- A. Section 16110: Raceways and Conduit Systems.
- B. Section 16190: Supporting Devices and Hangers.

1.03 SUBMITTALS

- A. Submittal of products furnished under this Section is not required.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. For exterior work, provide galvanized sheet metal boxes of code thickness with lapped and welded joints, 3/4" flanges, bolted covers with full gaskets forming a completely raintight assembly, equal to Keystone 19000, and 37900 series.
- B. For exterior work in graded areas outside the building, provide heavy-duty sidewalk junction boxes. Covers shall be fully gasketed, watertight and secured with plated screws or bolts equal to Quazite type PC.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Provide junction boxes as shown on drawings and otherwise where required, sized according to number of conductors in box or type of service to be provided. Minimum junction box size 4" square and 2-1/8" deep.
- B. Provide screw covers for junction boxes.
- C. Install boxes in conduit runs wherever necessary to avoid excessive runs or bends. Do not exceed 100' runs without pull boxes.

- D. Rigidly secure boxes. Conduit runs will not be considered as adequate support.
- E. Install boxes with covers in accessible locations. Size boxes in accordance with Articles 370 and 373 of the National Electric Code.

END OF SECTION

SECTION 16134

PANELBOARDS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Section 16010.
- B. Provide circuit breaker type panelboards as indicated on drawings and as specified hereinafter.

1.03 SUBMITTALS

- A. Submit product data for review.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Square "D".
- B. G.E.
- C. Cutler-Hammer/Westinghouse.
- D. Siemens.

2.02 PANELBOARD TYPES

- A. Circuit breaker type branch-circuit panelboards for 120/208 volts, 3-phase, 4-wire service shall be Square "D" type NQOD with circuit breakers rated 10,000 AIC.
- B. Circuit breaker type branch-circuit panelboards for 277/480 volts, 3-phase, 4-wire service, shall be Square "D" type NEHB with circuit breakers rated 14,000 AIC.
- C. Provide circuit breakers of the interrupting rating shown on the drawings where the available fault current exceeds ratings shown above.
- D. Bus bars shall be aluminum

2.03 REQUIRED FEATURES

- A. Provide circuit breakers with lugs (both main and branch circuit lugs) suitable and UL approved for both aluminum and copper conductors.

- B. Provide electrically isolated factory installed neutral bus.
- C. Provide separate ground bars complete with lugs or connectors on bar.
- D. Provide panel doors equipped with chrome-plated locks and catches, all keyed alike. Provide two keys for each lock. Provide fronts with adjustable indicating trim clamps.
- E. Provide thermal magnetic circuit breakers which are fully rated and temperature rated for a 40 degrees C ambient. Breakers shall be quick-make, quick-break type with trip indication shown by handle position other than ON or OFF and with a common trip on all multi-pole breakers.
- F. Refer to drawings for numbers of branch circuits, their ratings, number of poles and arrangements.
- G. Panelboards shall be NEMA 3R.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Ground separate ground bars to panel boxes and to the main service entrance ground bus with a code-sized grounding conductor installed in the same conduit as the phase and neutral conductors.
- B. Provide six circuit breaker handle lock-on devices for each branch-circuit panelboard, installed as directed by Owner's Representative, to prevent unauthorized personnel from turning off circuits to controls, unit heaters, clocks, night lights. Turn spare lock-on devices over to the Owner's Representative.
- C. Provide typed directory cards under plastic on the doors of branch circuit panelboards. Directories shall indicate devices being served including space numbers or space names in which devices or fixtures are located. Space names and numbers shall match the graphics installed.
- D. Provide shunt trip circuit breakers for kitchen equipment branch circuits under range hoods.
- E. Director card identity spaces and spare breakers in panel.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Section 16010.
- B. Provide switches, receptacles, and other wiring devices as indicated on drawings.

1.02 SUBMITTALS

- A. Submit product data for review.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Arrow Hart
- B. Eagle
- C. Hubbell
- D. Leviton
- E. Pass and Seymour.
- F. Leviton numbers are used unless otherwise noted, but products of equivalent quality by named manufacturers will be acceptable.

2.03 RECEPTACLES IN OUTSIDE AREAS

- A. 20-Amp, 125 VAC Receptacles:
 - 1. Duplex type: Leviton No. 5362-I.
 - 2. Weatherproof type and cover: Leviton No. 4970.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Polarity: Wire receptacles so that the hot wire, neutral wire and ground wire connect to the proper terminals.

- B. Grounding: Install a No. 12 green ground wire from device grounding terminal back to grounding bus in panelboard, as noted on drawings.
- C. Install receptacles shown on the drawings as "special mounting height" at mounting height indicated on drawings.
- D. Receptacles shall be installed with ground pin up.

END OF SECTION

SECTION 16141

DEVICE PLATES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Section 16010.
- B. Provide device plates on switches, receptacles, and miscellaneous devices.

1.02 RELATED WORK

- A. Section 16140: Wiring Devices

1.03 SUBMITTALS

- A. Submit product data for review.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide plates from wiring device manufacturer, equal to Leviton Series 84000 stainless steel, .04" thick.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Install device plates in full contact with surface mounted box. Plates shall not project out from the edge of the box.

END OF SECTION

SECTION 16170
SAFETY SWITCHES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Sections 16010 and 16050.
- B. Provide horsepower rated, quick-make, quick-break, safety switches with the number of poles and fuses as required. For 240 volt switches use general duty type. For 600 volt switches, use heavy duty type. Provide Class R fuse in clips in each type.
- C. Switches shall have arc shields, be of enclosed construction and fusible or non-fusible as indicated. Switches shall be rated for 600-volt AC service as required.
- D. Switches shall be capable of interrupting locked rotor currents of motors which they serve.

1.02 SUBMITTALS

- A. Submit product data for review.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Square D.
- B. G.E.
- C. Cutler-Hammer/Westinghouse.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Provide non-fusible switches at remote motor locations (rain-tight where required) as indicated on drawings and as required by NEC.
- B. Identify safety switches with bakelite nameplates in accordance with Section 16050.
- C. Safety switches shall be NEMA 3R.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES AND HANGERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Sections 16010.
- B. Provide a system of supporting devices and hangers for support or bracing of conduit, electrical equipment, including safety switches, fixtures, panelboards, outlet boxes, junction boxes, and cabinets.

1.02 RELATED WORK

- A. Section 16110: Raceways and Conduit Systems.
- B. Section 16130: Outlet Boxes.
- C. Section 16131: Pull and Junction Boxes.

1.03 SUBMITTALS

- A. Submittals are not required.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Erico Products, Inc.
- B. Steel City.
- C. Minerallac.
- D. Rayco Fastners.

2.02 TYPES OF SUPPORTING DEVICES

- A. Provide appropriate supporting means as detailed on Drawings.
 - 1. Conduit clips - 2" maximum conduit.
 - 2. Combination push-in conduit clips - 1" maximum conduit.
 - 3. Combination conduit hanger clamps - 2" maximum conduit.
 - 4. Flexible conduit clips - 1" maximum flexible conduit.
 - 5. Special combination conduit clips - 1" maximum conduit.
 - 6. One hole steel straps.

7. Conduit hangers - 4" maximum conduit.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Secure conduits to within 3 feet of each outlet box, junction box, cabinet and fitting and at intervals not to exceed ten feet in accordance with current edition of the National Electrical Code.
- B. Install clamps secured to structure for feeder and other conduits routed against the structure. Use drop rods and hangers to support conduits run apart from the structure.
- C. Provide and install suitable angle iron, channel iron or steel metal framing with accessories to support or brace electrical equipment including safety switches, fixtures and panelboards.
- D. Use of chains, perforated iron, baling wire, or tie wire for supporting conduit runs will not be permitted.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Comply with the provisions of Section 16010.
- B. The entire system of raceways and equipment shall be grounded in accordance with Article No. 250 and of the National Electrical Code and any local regulation or governing authority.

1.02 SUBMITTALS

- A. Submittals are not required for products in this Section.

PART 2 - PRODUCTS

2.01 REQUIREMENTS

- A. Ground clamps: OZ Electrical Manufacturing Company Type "CG", or equal by Steel City or Appleton.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. General
 - 1. Clean all conductive surfaces on equipment to be grounded, to assure good electrical continuity.
 - 2. Effectively bond all grounding conductors to grounding electrodes, equipment enclosures and ground busses.
 - 3. Locate all grounding attachments away from areas subject to physical damage. Provide protective covering as required.
 - 4. All PVC conduit shall have separate ground wire installed in accordance with Table 250-122 of the National Electrical Code.
- B. Feeder/Branch Circuits:
 - 1. Branch circuits shall have a separate green grounding conductor installed in same conduit as phase and neutral conductor from panel ground bus to device. Install an equal number of grounding and neutral conductors. The grounding conductor shall be sized in accordance with Table 250-122 of the National Electrical Code.
 - 2. Bond the receptacle ground pin to its box using a bonding jumper, except where isolated ground receptacles are required.

3. Flexible conduit will not be approved as a grounding means. Flexible conduit shall have a jumper wire sized to ampacity of branch breaker and connected to conduit system on both ends. This applies to fixtures, motors, controls and other devices.

3.02 TEST

- A. Ground on main service shall be tested using test equipment similar to a "Biddle" tester. Test data shall be submitted to Owner for approval and such approved test data shall become a part of the Operating and Maintenance Instruction Manual. In no event shall ground resistance exceed 25 OHMS. Additional rods or other means shall be employed when measured resistance exceeds 10 OHMS.

END OF SECTION

SECTION 16480

COMBINATION MOTOR STARTERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Motor starters.
- B. Provide wiring in accordance with Section 16010.

1.02 RELATED WORK

- A. Section 16110: Raceways and Conduit Systems
- B. Section 16121: Conductors

1.03 SUBMITTALS

- A. Submit product data for review.

PART 2 - PRODUCTS

2.01 STARTERS

- A. Design: NEMA standard, UL listed and CSA approved.
- B. Ratings: A/C symmetrical ratings of 50,000 amps for 460 volt equipment and 35000 amps for equipment of lower voltages. Provide higher ratings where available fault current exceeds these ratings and as called for on drawings.
- C. Size: In accordance with NEMA standards.
- D. Acceptable manufacturers: Allen Bradley, Square D, Cutler-Hammer/Westinghouse, General Electric.
- E. Starters shall include melting alloy overloads in each phase, and auxiliary interlocks as required for proper system operation.
- F. Provide Start-Stop selector switches in each starter.
- G. Provide lockable combination starters with motor circuit protectors sized in accordance with the NEC Article 430.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Install motor starters in accordance with manufacturer's recommendations and requirements of NEC.
- B. Provide thermal overloads at system startup in accordance manufacturer's recommendation for specific application.
- C. Connect equipment ready for operation.
- D. Coordinate equipment locations and starter sizes with Contract Documents, submittals, and shop drawings.
- E. Verify phase rotation of motors.
- F. Identify starters.
- G. Starters shall be NEMA 3R.

END OF SECTION

C

C

C

CR

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FIELD INSTRUMENT LIST

Solutia Krummrich
Carbon Treatment System
Advent Project No. 02607

Issue Date: 23-Jul-03
Revision: B
Description: Contingency Plan


LINE NO.	P&ID NO.	I.D.	TAG NO.	TYPE	LOCATION	I/O TYPE	RANGE	UNITS	REMARKS	R E V
CARBON TREATMENT SYSTEM UNITS 1 & 2										
1	PID-1	FIQ	FIQ-1	Turbine Meter	Flow indicator and totalizer for V-1A/B influent			gal		B
2	PID-1	FIQ	FIQ-2	Turbine Meter	Flow indicator and totalizer for V-2A/B influent			gal		B
3	PID-1	PI	PI-1A	Pressure Gauge	V-1A/B influent sample port		0-100	psig	Vendor Supplied	B
4	PID-1	PI	PI-1B	Pressure Gauge	V-1A/B effluent sample port		0-100	psig	Vendor Supplied	B
5	PID-1	PI	PI-1C	Pressure Gauge	V-1A/B drain line/backwash influent		0-100	psig	Vendor Supplied	B
6	PID-1	PI	PI-1D	Pressure Gauge	V-1A vent line		0-100	psig	Vendor Supplied	B
7	PID-1	PI	PI-1E	Pressure Gauge	V-1B vent line		0-100	psig	Vendor Supplied	B
8	PID-1	PI	PI-1F	Pressure Gauge	V-1A effluent sample port		0-100	psig	Vendor Supplied	B
9	PID-1	PI	PI-1G	Pressure Gauge	V-1B effluent sample port		0-100	psig	Vendor Supplied	B
10	PID-1	PI	PI-2A	Pressure Gauge	V-2A/B influent sample port		0-100	psig	Vendor Supplied	B
11	PID-1	PI	PI-2B	Pressure Gauge	V-2A/B effluent sample port		0-100	psig	Vendor Supplied	B
12	PID-1	PI	PI-2C	Pressure Gauge	V-2A/B drain line/backwash influent		0-100	psig	Vendor Supplied	B
13	PID-1	PI	PI-2D	Pressure Gauge	V-2A vent line		0-100	psig	Vendor Supplied	B
14	PID-1	PI	PI-2E	Pressure Gauge	V-2B vent line		0-100	psig	Vendor Supplied	B
15	PID-1	PI	PI-2F	Pressure Gauge	V-2A effluent sample port		0-100	psig	Vendor Supplied	B
16	PID-1	PI	PI-2G	Pressure Gauge	V-2B effluent sample port		0-100	psig	Vendor Supplied	B
17	PID-1	PSE	PSE-1A	Rupture Disk	Rupture disk for V-1A (influent line)				Vendor Supplied	B
18	PID-1	PSE	PSE-1B	Rupture Disk	Rupture disk for V-1B (influent line)				Vendor Supplied	B
19	PID-1	PSE	PSE-2A	Rupture Disk	Rupture disk for V-2A (influent line)				Vendor Supplied	B
20	PID-1	PSE	PSE-2B	Rupture Disk	Rupture disk for V-2B (influent line)				Vendor Supplied	B
CARBON TREATMENT SYSTEM UNITS 3 & 4										
21	PID-2	FIQ	FIQ-3	Turbine Meter	Flow indicator and totalizer for V-3A/B influent			gal		B
22	PID-2	FIQ	FIQ-4	Turbine Meter	Flow indicator and totalizer for V-4A/B influent			gal		B
23	PID-2	PI	PI-3A	Pressure Gauge	V-3A/B influent sample port		0-100	psig	Vendor Supplied	B
24	PID-2	PI	PI-3B	Pressure Gauge	V-3A/B effluent sample port		0-100	psig	Vendor Supplied	B
25	PID-2	PI	PI-3C	Pressure Gauge	V-3A/B drain line/backwash influent		0-100	psig	Vendor Supplied	B
26	PID-2	PI	PI-3D	Pressure Gauge	V-3A vent line		0-100	psig	Vendor Supplied	B
27	PID-2	PI	PI-3E	Pressure Gauge	V-3B vent line		0-100	psig	Vendor Supplied	B
28	PID-2	PI	PI-3F	Pressure Gauge	V-3A effluent sample port		0-100	psig	Vendor Supplied	B
29	PID-2	PI	PI-3G	Pressure Gauge	V-3B effluent sample port		0-100	psig	Vendor Supplied	B
30	PID-2	PI	PI-4A	Pressure Gauge	V-4A/B influent sample port		0-100	psig	Vendor Supplied	B
31	PID-2	PI	PI-4B	Pressure Gauge	V-4A/B effluent sample port		0-100	psig	Vendor Supplied	B
32	PID-2	PI	PI-4C	Pressure Gauge	V-4A/B drain line/backwash influent		0-100	psig	Vendor Supplied	B
33	PID-2	PI	PI-4D	Pressure Gauge	V-4A vent line		0-100	psig	Vendor Supplied	B
34	PID-2	PI	PI-4E	Pressure Gauge	V-4B vent line		0-100	psig	Vendor Supplied	B
35	PID-2	PI	PI-4F	Pressure Gauge	V-4A effluent sample port		0-100	psig	Vendor Supplied	B
36	PID-2	PI	PI-4G	Pressure Gauge	V-4B effluent sample port		0-100	psig	Vendor Supplied	B
37	PID-2	PSE	PSE-3A	Rupture Disk	Rupture disk for V-3A (influent line)				Vendor Supplied	B
38	PID-2	PSE	PSE-3B	Rupture Disk	Rupture disk for V-3B (influent line)				Vendor Supplied	B

FIELD INSTRUMENT LIST

Solutia Krummrich
Carbon Treatment System
Advent Project No. 02607

Issue Date: 23-Jul-03
Revision: B
Description: Contingency Plan

LINE NO.	P&ID NO.	I.D.	TAG NO.	TYPE	LOCATION	I/O TYPE	RANGE	UNITS	REMARKS	R E V
39	PID-2	PSE	PSE-4A	Rupture Disk	Rupture disk for V-4A (influent line)				Vendor Supplied	B
40	PID-2	PSE	PSE-4B	Rupture Disk	Rupture disk for V-4B (influent line)				Vendor Supplied	B
BACKFLUSH EQUIPMENT AND TRANSFER UTILITIES										B
41	PID-3	HS	HS-4	Manual Switch	Manual switch for C-1 motor				Vendor Supplied	B
42	PID-3	HS	HS-1	Manual Switch	Manual switch for P-1 motor					B
43	PID-3	HS	HS-2	Manual Switch	Manual switch for P-2 motor					B
44	PID-3	HS	HS-3	Manual Switch	Manual switch for P-3 motor					B
45	PID-3	LAH	LAH-1	High Level Alarm	High level alarm for T-1					B
46	PID-3	LCV	LCV-1	Level Control Valve	Control valve for effluent flow into T-1					B
47	PID-3	LSH	LSH-1	High Level Switch	High level switch for T-1					B
48	PID-3	PCV	PCV-1	Pressure Control Valve	Regulator for column transfer air		30	psig		B
49	PID-3	PCV	PCV-2	Pressure Control Valve	Regulator for trailer transfer air		15	psig		B
50	PID-3	PI	PI-1A	Pressure Gauge	P-1 discharge line		0-100	psig		B
51	PID-3	PI	PI-4A	Pressure Gauge	C-1 discharge line		0-50	psig	Vendor Supplied	B
52	PID-3	PI	PI-4B	Pressure Gauge	C-1 receiver tank		0-50	psig	Vendor Supplied	B
53	PID-3	PI	PI-2	Pressure Gauge	P-2 discharge line		0-100	psig		B
54	PID-3	PI	PI-3	Pressure Gauge	P-3 discharge line		0-100	psig		B
55	PID-3	PSHL	PSHL-4	Differential Pressure Switch	C-1 receiver tank pressure switch				Vendor Supplied	B
56	PID-3	PSV	PSV-4	Pressure Relief Valve	Pressure relief for C-1 receiver tank		125	psig	Vendor Supplied	B
57	PID-3	TI	TI-4	Temperature Indicator	C-1 discharge line		0-250	deg F	Vendor Supplied	B

 THE ADVENT GROUP, INC. INSTRUMENT SPECIFICATION Project No.: 02691 Client: Solutia Krummrich Project Name: Carbon Treatment System		TURBINE FLOWMETERS				SPEC. NO.		REV. A	
		NO	BY	DATE	REVISION	SHEET OF		DATE	
		A	CLC	11/20/02	Pre-Final Design	1 of 1		11/20/02	
		B	CLC	7/23/03	Contingency Plan	BY	CHK'D	APPR.	
						CLC			
						P.O.			
						REQ.			
METER	1	Tag Number	FIQ-1 through FIQ-4						
	2	Service	Groundwater						
	3	Meter Location	Influent Line to Carbon Adsorbers PV-1A/B through PV-4A/B						
	4	Line Size	4"						
	5	End Connections	150# ANSI F.F.						
	6	Body Rating	275#						
	7	Nominal Flow Range	350 gpm						
	8	Accuracy	± 0.5%						
	9	Linearity	±0.02 % over 10:1 range, std.						
	10	K Factor, Cycles per Vol. Unit	Programmable, 0.001 to 999999.999 pulses per liter/gal., etc.						
	11	Excitation	N/A						
	12	Materials: Body	304 SS						
	13	Support	304 SS						
	14	Shaft	ANSI 431						
	15	Flanges	Carbon Steel						
	16	Rotor	ANSI 431						
	17	Bearings: Type	Sleeve						
	18	Bearing Material	Tungsten Carbide						
	19	Max. Speed							
	20	Min. Output Voltage	20 mV P/P (50 m transmission max.)						
	21	Pickoff Type	Reluctance type pickoff coil						
	22	Enclosure Class	IP66 (NEMA 4)						
	FLUID DATA	24	Fluid	Groundwater					
25		Flow Rate: Min. Max.	150 gpm		350 gpm				
26		Normal Flow	200 gpm						
27		Operating Pressure							
28		Back Pressure							
29		Operating Temp. Max. Min.	100 deg. F		40 deg. F				
30		Operating Specific Gravity	1.0						
31		Viscosity Range	0.9-1.2 cP						
32		Percent Solids & Type	< 20 ppm, sand/grit						
33									
SECONDARY INSTR.	34	Secondary Instr. Tag No.							
	35	Preamplifier	N/A						
	36	Function	Flow rate, Accumulated total						
	37	Mounting	Meter						
	38	Power Supply	Lithium Battery						
	39	Scale Range	0-350 GPM						
OPTIONS	40	Output Range	None						
	41	Totalizer Type	Dual; 1 Resettable, 1 non-resettable						
	42	Compensation	N/A						
	43	Preset Counter	N/A						
	44	Enclosure Class	IP66 (NEMA 4)						
	45	Strainer Size & Mesh	None						
	46								
	47								
	48	Manufacturer	Trimec Industries						
	49	Meter Model No.	TP100C4C1211R1						
	50	Secondary Instr. Model No.							
Notes:									

 THE ADVENT GROUP, INC		CONTROL VALVES ON/OFF				SPEC. No.	REV. A				
		NO	BY	DATE	REVISION	SHEET	OF	DATE			
		A	ATL	11/18/02	Pre-Final Design	1	1	11/18/02			
		B	CCL	7/23/03	Contingency Plan	BY	CHK'D	APPR.			
					RevBy	CLC					
					P.O.						
					REQ.						
Project:											
1	Valve Tag LCV-1		Service : T-1 Supply Line			P&ID : PID-3					
	Fluid Code		Desc. : Level Control for Backflush Supply Tank T-1			Line no.:					
2	SERVICE CONDITIONS	Flow rate	Units	Max Flow	Norm Flow	Min Flow	Shut Off				
3			gpm	1000	600	0	-				
4		Inlet Pressure P1	psig	~20	~30	~20					
5		Outlet Pressure P2	psig	0	0	0					
6		Differential Pressure dP = P1 - P2	psig	~20	~30	~20					
7		Inlet Temperature	°F	60	60	60					
8		Spec. Weight / Spec. Gravity / Mol. We	SG	1	1	1	-				
9		Viscosity / Specific Heats Ratio	cP	1	1	1	-				
10		Vapor Pressure Pv / Crit Press PC					-				
11		Required Cv					-				
12		Travel	%				0				
13		* Predicted Sound press. level (at 1 m	dBA				-	Max. 85 dbA			
14	Compressibility (Z)										
15	Solids conc. / Part size										
16	VALVE BODY / BONNET	Pipe Line Size In 8" Out 8"	53	Type Hydraulic/Float							
17		Pipe Sch./W.thickn SCH 40 Out SCH 40	54					Manufacturer OCV			
18		Mater'l Carbon Steel ANSI 150# Ins Y	55								
19		* Type * Std / Full port	56	Size * Eff Area							
20		* Size 8" ANSI class 150#	57					Action Open / Close / Loc Close on Rising Level			
21		* Valve max P / T°	58								
22		* Manufacturer OCV	59	Min Required Press.							
23		* Model Model 8000LDM	60					Available Air Supply Pressure :			
24		* Body / Bonnet Mate Ductile Iron	61								
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44	* Stem Material	81					TESTS				
45	NEC Class Group Div.	82									1. Valve will accept full flow at 100% open when tank level is below set point.
46		83	NOTES								
47		84					S20.56				
48		85									Information supplied by manufacturer unless already specified
49			LCV-1								
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7400 East 42nd Place / Tulsa, Oklahoma 74145-4744 USA / Phone 918-627-1942 / Fax 918-622-8916
e-mail: sales@controlvalves.com / website: www.controlvalves.com

MATERIALS OF CONSTRUCTION

OCV Control Valve Model 8000 Size 8" ☒ Globe ☐ Angle

MAIN VALVE BODY & BONNET ☒ Ductile Iron, ASTM A536, 65-45-12 ☐ Cast Aluminum, 356-T6
☐ Cast Steel, ASTM A216, Grade WCB ☐ _____
☐ Stainless Steel, ASTM A743, Grade CF-8

END FLANGES/RATINGS ☒ ANSI B16.42, Class 150, flat face, 250 psi max. W.P. ☐ ANSI B16.5, Class 300, raised face, 740 psi max. W.P.
☐ ANSI B16.42, Class 300, raised face, 640 psi max. W.P. ☐ ANSI B2.1, Screwed ends, (female NPT), 640 psi max. W.P.
☐ ANSI B16.5, Class 150, raised face, 285 psi max. W.P. (Note: Cast Aluminum, flat face) ☐ _____

SEAT RING ☒ Cast Bronze, ASTM B62 ☐ _____
☐ Cast Stainless Steel, ASTM A743, Grade CF8

STEM ☒ Stainless Steel, AISI 303 ☐ _____
☐ Stainless Steel, Delrin-Sleeved

FITTINGS & TUBING ☒ Brass Fittings, Copper tubing ☐ Stn. Stl. fittings & tubing
☐ Steel Fittings, Stn. Stl. tubing ☐ _____

DIAPHRAGM & SEAT DISC ☒ Buna-N ☐ _____
☐ Viton

PILOT BODIES ☒ Cast Bronze, ASTM B62 ☐ _____
☐ Cast Stainless Steel, ASTM A743, Grade CF-8

STRAINER ☒ Y-type ☐ Inline-type ☐ _____

STOP COCKS ☒ Yes ☐ No ☐ _____

ELECTRICAL BODIES ENCLOSURE ACTUATION BRAND/MODEL
(when applicable) ☐ Brass ☐ General Purpose, NEMA 1,3,4, & 4X ☐ Energize to open ☐ _____
SOLENOIDS ☐ Stn. Stl. ☐ Explosion Proof, NEMA 4,7, & 9 ☐ Energize to close ☐ _____

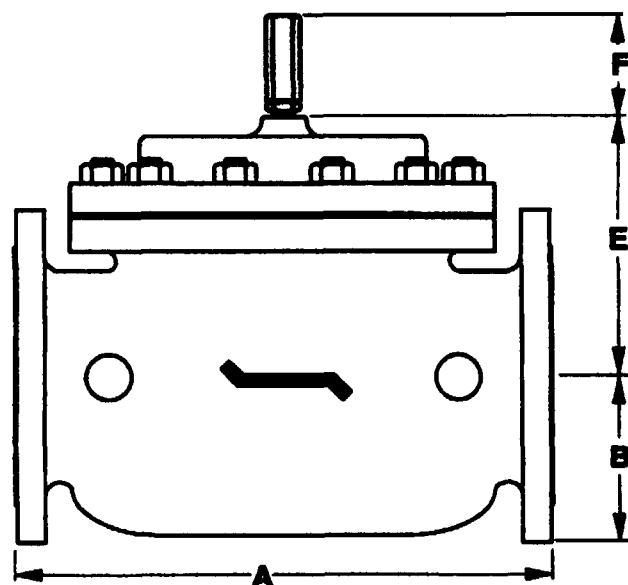
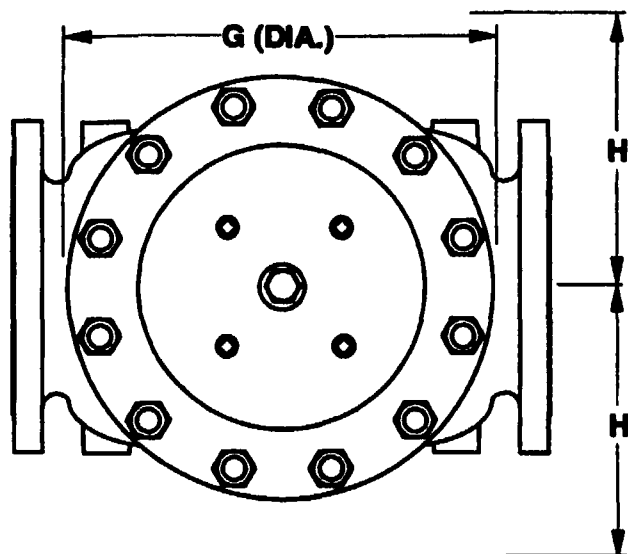
A.C. VOLTAGES/RATINGS ☐ 120V, 60Hz / 100V, 50Hz ☐ 480V, 60Hz / 440V, 50Hz
☐ 240V, 60Hz / 220V, 50Hz ☐ 24V, 60Hz

D.C. VOLTAGES ☐ 6V ☐ 12V ☐ 24V ☐ 120V ☐ 240V

LIMIT SWITCHES ACTION HOUSING
☐ SPDT Quantity _____ ☐ Weatherproof
☐ DPDT ☐ Explosion-Proof

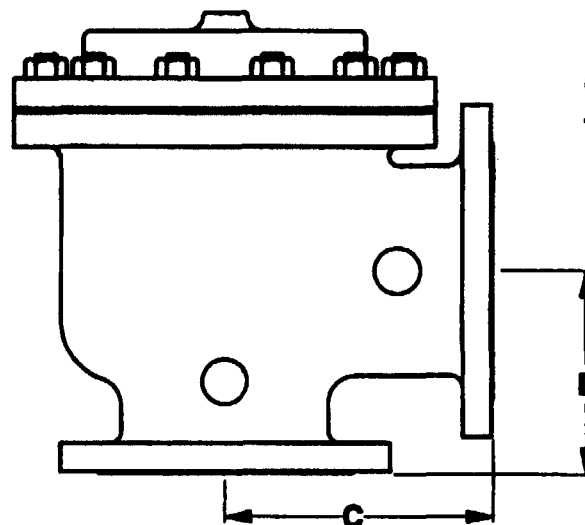
OTHER OPTIONS ☒ Visual Indicator ☐ _____
☐ Epoxy-Coating, std. 3-5 mils, inside/outside ☐ _____
☐ Epoxy-Coating, spcl. 10-12 mils, inside/outside ☐ _____
☐ Epoxy-Coating, spcl. Abranon, inside 10-12 mils, Dimetkote, outside 10-12 mils, (sea water coating) ☐ _____

TEMPERATURES Min. °F: ☐ -40 ☐ 0 ☒ +32 Max. °F: ☒ +180 ☐ +300 ☐ +400
°C: ☐ -40 ☐ -18 ☐ 0 °C: ☐ +82 ☐ +149 ☐ +204



REV. A SDJ 6-6-02

DIM	ANSI CLASS	VALVE SIZE												
		1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	24
A	SE	8.75	8.75	9.88	10.50	13.00	-	-	-	-	-	-	-	-
	150	8.50	8.50	9.38	10.50	12.00	13.50	17.75	25.38	29.75	34.00	39.00	40.38	62.00
	300	8.75	8.75	9.88	11.12	12.75	14.12	18.62	26.38	31.12	35.50	40.50	42.00	63.75
B	SE	1.44	1.44	1.69	1.88	2.25	-	-	-	-	-	-	-	-
	150	2.31	2.50	3.00	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.62	11.75	16.00
	300	2.62	3.06	3.25	3.75	4.12	5.00	6.25	7.50	8.75	10.25	11.50	12.75	18.00
C	SE	4.38	4.38	4.75	6.00	6.50	-	-	-	-	-	-	-	-
	150	4.25	4.25	4.75	6.00	6.00	7.62	10.00	12.69	14.88	17.00	-	20.81	-
	300	4.38	4.38	5.00	6.38	6.38	7.94	10.50	13.19	15.56	17.75	-	21.62	-
D	SE	3.12	3.12	3.88	4.00	4.50	-	-	-	-	-	-	-	-
	150	3.00	3.00	3.88	4.00	4.00	5.06	6.00	8.00	11.38	11.00	-	15.69	-
	300	3.25	3.25	4.12	4.38	4.38	5.38	6.50	8.50	12.06	11.75	-	16.50	-
E	ALL	6.00	6.00	6.00	7.00	6.50	8.00	10.00	11.88	15.38	17.00	18.00	19.00	27.00
F	ALL	3.88	3.88	3.88	3.88	3.88	3.88	3.88	6.38	6.38	6.38	6.38	6.38	8.00
G	ALL	6.00	6.00	6.75	7.69	8.75	10.00	14.00	21.00	24.50	28.00	31.25	34.50	52.00
H	ALL	10.00	10.00	11.00	11.00	11.00	12.00	13.00	14.00	17.00	18.00	20.00	20.00	28.50



NOTE: 3" VALVE DIMENSIONS
ARE FOR NEW MODEL 3100

TOLERANCES

UNLESS NOTED
FRACTIONAL $\pm 1/64$
DECIMAL $\pm .005$
MACH. FINISH 125/
ANGULAR $\pm 1/2^\circ$

DRAWN BY
SDJ

DATE
10-6-97

CHKD. BY

DATE

OCV Control Valves
TULSA, OKLAHOMA U.S.A.

GENERAL VALVE DIMENSIONS

SIZE	DRAWING NUMBER	REV.
A	65D	A

NOTES:

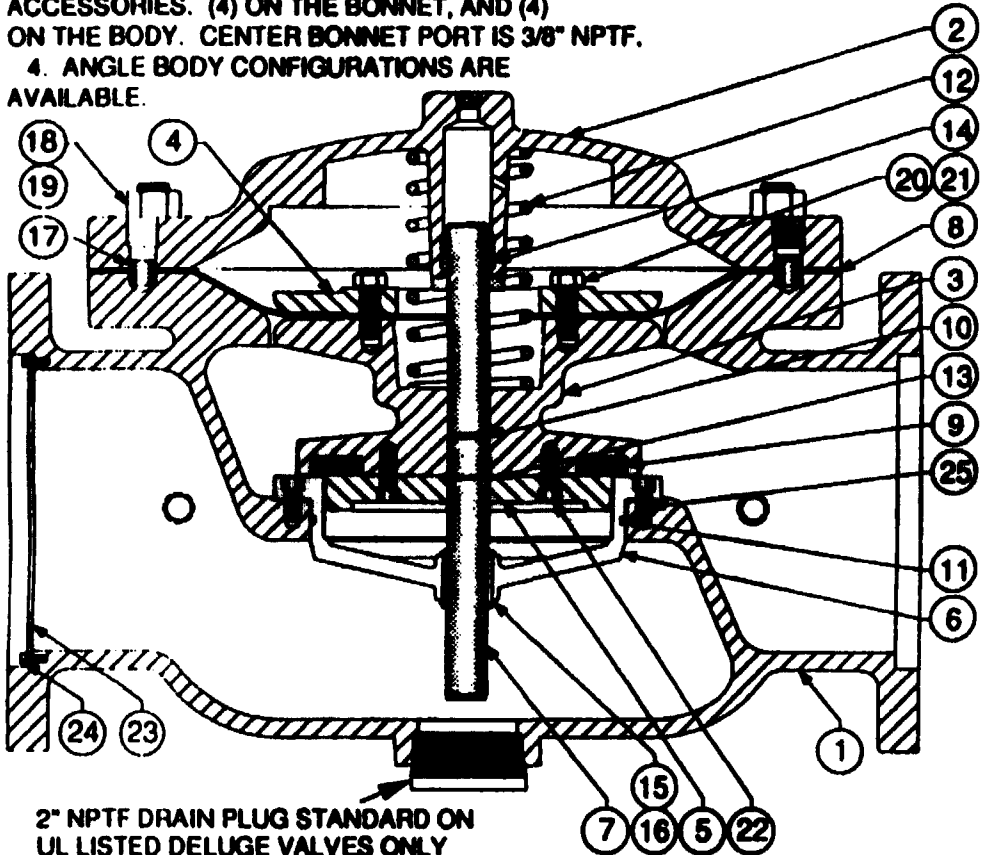
● 1. USED WHEN STN STL SEAT RING IS FURNISHED.

■ 2. USED ON RATE-OF-FLOW CONTROL VALVE ONLY.

3. TOTAL OF (8) 1/2" NPTF PIPE TAPS ARE PROVIDED FOR THE PILOT SYSTEM AND ACCESSORIES. (4) ON THE BONNET, AND (4) ON THE BODY. CENTER BONNET PORT IS 3/8" NPTF.

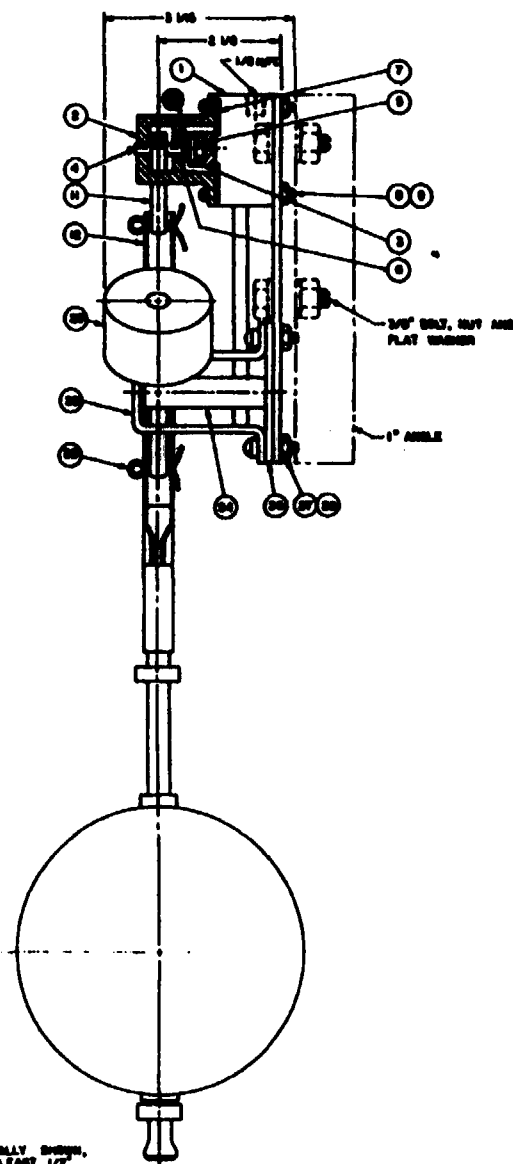
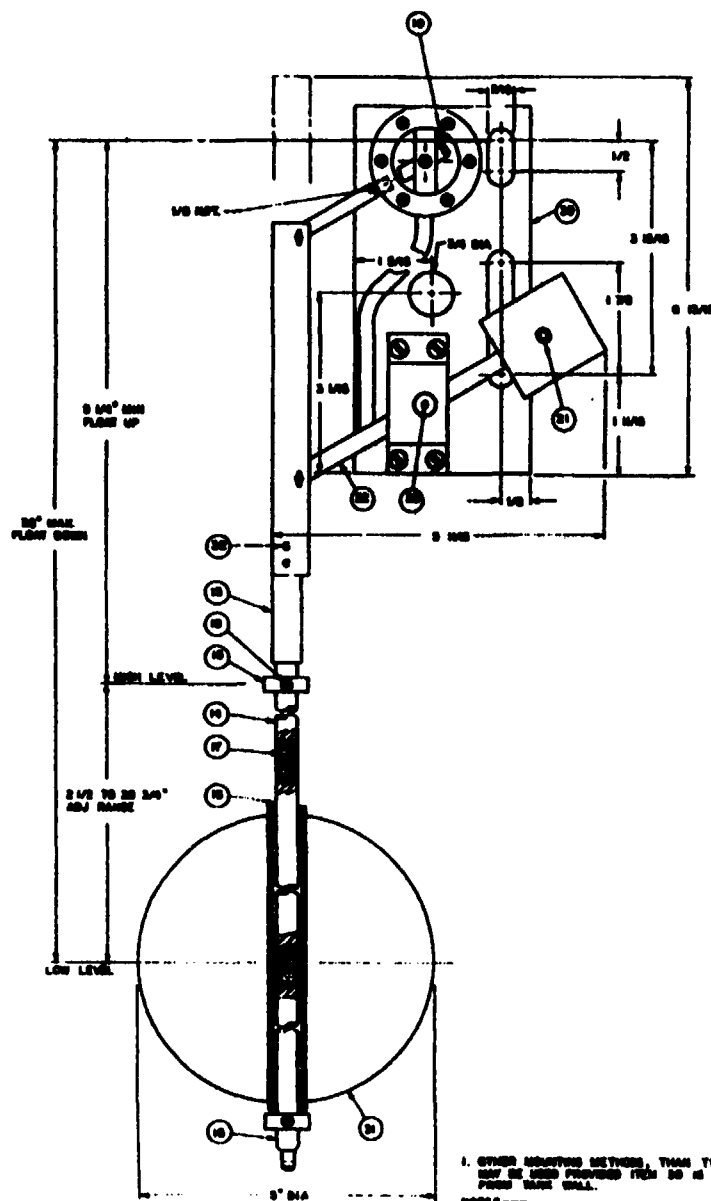
4. ANGLE BODY CONFIGURATIONS ARE AVAILABLE.

▲ - RECOMMENDED SPARE PARTS (INCLUDED IN REPAIR KITS)
BUNA-N KIT PN 904084
VITON KIT PN 904184
EPDM KIT PN 904484



ITEM	PART NO.	QTY	DESCRIPTION	MATERIAL
1	301084 301384 301584	1	BODY, 150#	301684 301784 STEEL ALUMINUM
2	303084 303384 303584	1	BONNET	DUCT IRON STEEL ALUMINUM
3	305084 305584	1	SPOOL	DUCT IRON ALUMINUM
4	307084 307584	1	DIAPHRAGM PLATE	DUCT IRON ALUMINUM
5	309084 309584	1	SEAT RETAINER	DUCT IRON ALUMINUM
6	311184 311784	1	SEAT RING	BRONZE STN STL
7	313784 313084	1	STEM (313085 MONEL)	STN STL STN STL/DELRI
8	690084 690184	1	DIAPHRAGM	BUNA-N NYLON VITON NYLON
9	690584 691584	1	SEAT DISC	BUNA-N VITON
10	610119	1	O-RING (611119 VIT) (614119 EP)	BUNA-N
11	610288 611288	1	O-RING (614288 EPDM)	BUNA-N VITON
12	690724	1	SPRING	STN STL
13	690723	1	SNAP RING	STN STL
14	300284 300285	1	UPPER BUSHING	BRONZE TEFLON
15	300074	1	LOWER BUSHING	TEFLON
16	630713	2	SNAP RING	STN STL
17	300706	2	DOWEL PIN	STN STL
18	300464	12	STUD (300864 STN STL)	ZINC PL STL
19	590010	12	NUT (590707 STN STL)	ZINC PL STL
20	651704	8	HEX HD CAPSCREW	STN STL
21	655703	8	LOCKWASHER	STN STL
22	539718	8	SKT HD CAPSCREW	STN STL
23	305704	1	ORIFICE PLATE, STD BORE	STN STL
24	539702	4	SKT HD CAPSCREW	STN STL
25	630711	8	SKT HD CAPSCREW	STN STL

				MATERIAL	TOLERANCES	Control Valves TULSA, OKLAHOMA U.S.A.		
					UNLESS NOTED FRACTIONAL ±1/64 DECIMAL ±.005 MACH. FINISH 125/ ANGULAR ±1/2°	8" BASIC VALVE		
CHG	E.C. NO.	DATE	BY	NO. REQ'D	DRAWN BY RON	DATE 10-1-97	SIZE A	DRAWING NUMBER 3200
REVISIONS				SCALE 20%	CHKD. BY	DATE		REV. A
REF DWG NO'S								



1. OTHER ADJUSTING METHODS, THAN TYPICALLY SHOWN, MAY BE USED PROVIDED ITEM DO IS AT LEAST 1/2\"/>

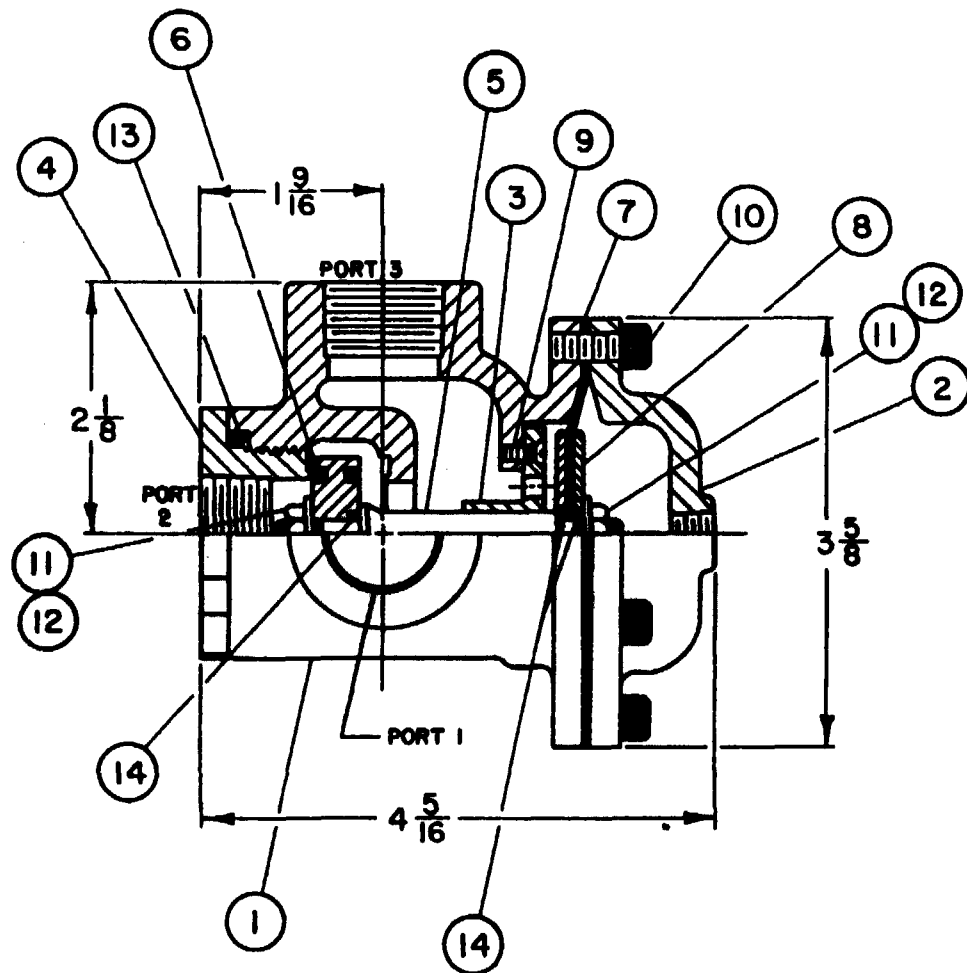
NOTES ---

23	625710	1	WASHER, FLAT	STN STL AHS 304
32	625702	2	PN. SPRNG	STN STL AHS 302
31	625708	1	FLOAT	STN STL AHS 304
30	320703	1	PLATE, MOUNTING	STN STL AHS 1000
29	320713	1	COUNTERWEIGHT	STN STL AHS 302
28	625718	4	NUT, HEX. HD.	STN STL AHS 304
27	625701	4	SCREW, PL. HD.	STN STL AHS 304
26	320707	1	SCREW, SOCKET	BRASS ASTM B16
25	320705	1	SCREW	BRASS ASTM B16
24	320706	1	STEM CWT PIVOT	BRASS ASTM B16
23	625707	1	PN. SPRNG	STN STL AHS 302
22	320705	1	ARM CWT	BRASS ASTM B16
21	625704	1	SCREW, SET	STN STL AHS 304
20	625705	2	PN. COTTER	STN STL AHS 302
19	625714	2	SCREW, SET	STN STL AHS 304
18	320708	2	COLLAR, STOP	STN STL AHS 302
17	616407	2	STUD	STN STL AHS 302
16	320709	1	ROD, FLOAT LWR.	STN STL AHS 304
15	320709	1	ROD, FLOAT EXT.	STN STL AHS 304
14	320709	1	ROD, FLOAT UPR.	STN STL AHS 304
13	320709	1	CONN. FLT. ROD	BRASS ASTM B16
12	320709	1	ARM, LINKAGE	BRASS ASTM B16
11	320709	1	ARM, ACTUATOR	STN STL AHS 302
10	625703	1	SCREW, RO. HD.	STN STL AHS 304
9	625712	6	SCREW, PL. HD.	STN STL AHS 304
8	625722	6	NUT, HEX. HD.	STN STL AHS 304
7	625713	1	GASKET	BRASS ASTM B16
6	611008	1	O-RING	BRASS ASTM B16
5	611711	1	SPRING	STN STL AHS 302
4	320709	1	ARM, ACTUATOR	STN STL AHS 302
3	320709	1	ARM, ACTUATOR	STN STL AHS 302
2	320709	1	ARM, ACTUATOR	STN STL AHS 302
1	320709	1	ARM, ACTUATOR	STN STL AHS 302

ITEM	QTY	DESCRIPTION	MATERIAL
1	1	ARM, ACTUATOR	STN STL AHS 302
2	1	ARM, ACTUATOR	STN STL AHS 302
3	1	ARM, ACTUATOR	STN STL AHS 302
4	1	ARM, ACTUATOR	STN STL AHS 302
5	1	ARM, ACTUATOR	STN STL AHS 302
6	1	ARM, ACTUATOR	STN STL AHS 302
7	1	ARM, ACTUATOR	STN STL AHS 302
8	1	ARM, ACTUATOR	STN STL AHS 302
9	1	ARM, ACTUATOR	STN STL AHS 302
10	1	ARM, ACTUATOR	STN STL AHS 302
11	1	ARM, ACTUATOR	STN STL AHS 302
12	1	ARM, ACTUATOR	STN STL AHS 302
13	1	ARM, ACTUATOR	STN STL AHS 302
14	1	ARM, ACTUATOR	STN STL AHS 302
15	1	ARM, ACTUATOR	STN STL AHS 302
16	1	ARM, ACTUATOR	STN STL AHS 302
17	1	ARM, ACTUATOR	STN STL AHS 302
18	1	ARM, ACTUATOR	STN STL AHS 302
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23	1	ARM, ACTUATOR	STN STL AHS 302
24	1	ARM, ACTUATOR	STN STL AHS 302
25	1	ARM, ACTUATOR	STN STL AHS 302
26	1	ARM, ACTUATOR	STN STL AHS 302
27	1	ARM, ACTUATOR	STN STL AHS 302
28	1	ARM, ACTUATOR	STN STL AHS 302
29	1	ARM, ACTUATOR	STN STL AHS 302
30	1	ARM, ACTUATOR	STN STL AHS 302
31	1	ARM, ACTUATOR	STN STL AHS 302
32	1	ARM, ACTUATOR	STN STL AHS 302

814 VERTICAL FLOAT PIVOT

814



NOTE:

1. WHEN ORDERING PARTS, PLEASE SPECIFY;
ITEM NO., PART NO. AND MATERIAL.

2. ▲ RECOMMENDED SPARE PARTS.

▲ 14	611010	3	O-RING	VITON
▲ 13	610222	1	O-RING	BUNA-N
12	685763	2	LOCKWASHER	STAINLESS STEEL
11	590712	2	HEX HEAD JAM NUT	STAINLESS STEEL
10	530701	6	SOCKET HD. CAPSCREW	STAINLESS STEEL
9	532735	2	FLAT HEAD SCREW	STAINLESS STEEL
8	308135	2	DIAPHRAGM PLATE	BRASS
	308735	2	DIAPHRAGM PLATE	STAINLESS STEEL
▲ 7	694035	1	DIAPHRAGM	BUNA-N
	694135	1	DIAPHRAGM	VITON
▲ 6	310736	1	SEAT DISC	STN. STL./BUNA-N
	310737	1	SEAT DISC	STN. STL./VITON
5	314735	1	STEM	STAINLESS STEEL
4	300171	1	ADAPTER	BRASS
	300771	1	ADAPTER	STAINLESS STEEL
3	300164	1	GUIDE PLATE	BRASS
	300764	1	GUIDE PLATE	STAINLESS STEEL
2	304135	1	BONNET	BRONZE
	304735	1	BONNET	STAINLESS STEEL
1	302135	1	BODY	BRONZE
	302735	1	BODY	STAINLESS STEEL

ITEM	PART NO.	QTY.	DESCRIPTION	MATERIAL
------	----------	------	-------------	----------

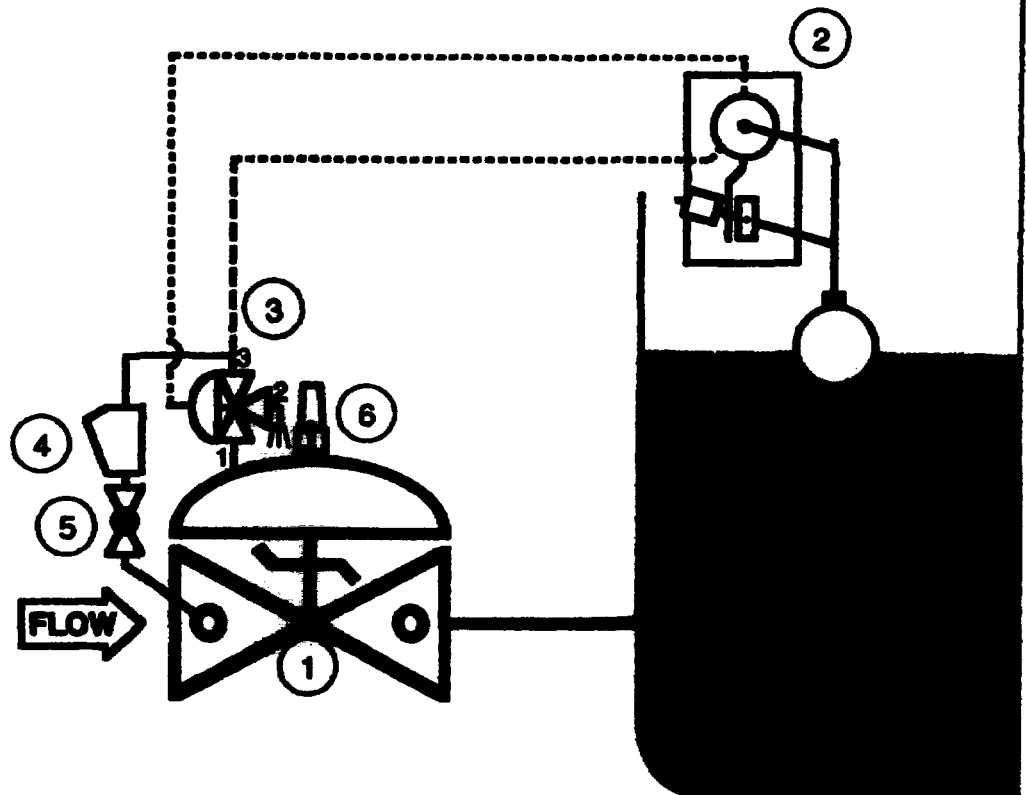
PARTS LIST

E					MATERIAL	TOLERANCES			
D						UNLESS NOTED FRACTIONAL ± 1/64 DECIMAL ± .005 MACH FINISH 125 ANGULAR ± 1/2°			
C							THREE-WAY PILOT		
B									
A					NO REQ'D	DRAWN BY B.R.W.	DATE 7-28-83	DRAWING NUMBER	REV
CHG	E. C. NO.	DATE	BY		SCALE	CHNG BY	DATE	B	3600
REVISIONS					REF DWG NO'S				

MODEL 8000 **8-24"**

RON
11-29-95

LEVEL CONTROL VALVE



----- INDICATES FIELD-CONNECTED LINES

ITEM	PART NO.	QTY	DESCRIPTION
1	65	1	BASIC VALVE ASSEMBLY
2	814	1	THREE-WAY FLOAT PILOT
3	3600	1	THREE-WAY AUXILIARY PILOT
4	159	1	Y-STRAINER
5	141-4	1	ISOLATION BALL VALVE
6	155	1	VISUAL INDICATOR (OPTIONAL)

2

2

2

2

OPERATING MANUAL

DUAL MODULE GRANULAR CARBON ADSORPTION SYSTEM



CALGON CARBON CORPORATION

PROPERTY OF CALGON CARBON CORPORATION

The service agreement between the Subscriber and Calgon Carbon Corporation is binding and is not superseded by any part of this Operating Manual without mutual agreement.

This manual is to be returned to Calgon Carbon Corporation upon termination of the contract between Calgon Carbon Corporation and the Subscriber.

OPERATING MANUAL

**DUAL MODULE
GRANULAR CARBON ADSORPTION SYSTEM**

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1.0 INTRODUCTION

This manual covers a general description and operating procedures for a Dual Module granular carbon adsorption system. This system is designed to treat liquid streams containing organic compounds amenable to adsorption using Calgon Carbon Corporation's granular activated carbon products. If the guidelines in this manual are read and followed carefully, the system can be operated efficiently and safely with minimal operating expense.

The recommended operating practices set forth in this manual are patterned to suit normal operating conditions. Different conditions may require modifications of these operating practices. Since varying operating conditions or problems may arise over long term operation, the skill and judgement of the operating personnel should be exercised when needed.

This manual should be available to operating personnel and engineers so that the operating instructions are followed. Record all operating data and minor maintenance work in an operator's logbook. Only trained personnel should operate the system. If further information beyond what is contained in this manual is required, please contact the nearest Calgon Carbon Corporation regional sales office for assistance.

1.1 SPECIFICATIONS & OPERATING CONDITIONS

1. Adsorber Vessel Specifications

Material of Construction: Carbon Steel

Tank Lining: Plasite 4110

Type of Heads:

Paint: Ceilcote Flakeline 600

Top: ASME F&D

Bottom: ASME F&D

Diameter: 10 ft

Straight Side Height: 8 ft

Design Temperature: 150°F

Design Pressure: ASME Code 75 psig @150°F

Vessel Capacities

Vessel Volume: 5950 gal.

Maximum Flow Rate Series: 300 gpm

Maximum Flow Rate Parallel: 600 gpm

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<i>Carbon Type</i>	<i>Bed Volume, gal</i>	<i>Empty Bed Contact Time @300 gpm (min/bed)</i>	
		<i>Series</i>	<i>Parallel</i>
Filtrisorb 100	5160	17.2	34.4
Filtrisorb 200	5160	17.2	34.4
Filtrisorb 300	5340	17.8	35.6
Filtrisorb 400	5540	18.5	36.9
Reactivated	4675	15.6	31.2

2. System Weights & Dimensions (Approximate):

Shipping Weight (Empty): 40,000 lbs.

Operating Weight (Full w/Liquid + Carbon): 160,000 lbs.

Overall Length: 20'-11" Overall Width: 11'-11" Overall Height: 13'-5:"

3. Vessel Accessories/Piping

Piping:

Process Piping: 3" or 4" PPL Lined Steel

Carbon Transfer Piping: 4" PPL Lined Steel

3. Vessel Accessories/Piping

Pressure Relief:

Pressure Relief Device: (Rupture Disk/Relief Valve)

Rupture Disk Material of Construction: Graphite

Rupture Disk Stamped Burst Pressure: 75 psig

Rupture Disk Recommended Operating Ratio: 75%

Recommended Maximum Inlet Pressure: 56 psig



4. Carbon

<i>Carbon Type</i>	<i>Mesh Size</i>
Filtrisorb 100	8 x 30
Filtrisorb 200	12 x 40
Filtrisorb 300	8 x 30
Filtrisorb 400	12 x 40
Reactivated	8 x 40

Initial Fill: 40,000 lbs.
Quantity per vessel: 20,000 lbs.

5. Other Options:

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6. Carbon Delivery

	<i>Dump Truck * (Atmospheric)</i>	<i>Standard Trailer (15 psig Hopper)</i>	<i>Lift Trailer (35 psig Hopper)</i>	<i>Triple Compartment Trailer</i>
Carbon (lbs):	40,000	20,000	20,000	20,000
Utility Requirements:				
Air (SCFM):	--	100	100	100
(PSIG):	--	100**	100***	100**
Water (GPM):	200-250	100	100	100
(PSIG):	80-120	--	--	--
Water Required to Fill Trailer (gallons):				Compartment End Center
Dry Carbon:	--	5,000	4,200	2,800 5,000
Pre-wetted Carbon:	--	4,200	3,500	2,500 4,200
Height Clearance (ft):	--	13	26	14
Empty Weight (lbs):	33,000	32,000	33,000	37,000
Filled Weight (lbs):				
Dry Carbon:	73,000	52,000	53,000	57,000
Wet Carbon (before drain):	--	94,000	95,000	99,000
(after drain):	--	72,000	73,000	77,000

*Unloading accomplished with eductor

**Regulated down to 15 psig max.

***Regulated down to 30 psig max.



1.2 GENERAL SYSTEM DESCRIPTION

The Dual Module adsorption system is a unit consisting of two (2) vertical pressure vessels, each containing 20,000 pounds of granular activated carbon (total of 40,000 pounds per system). The vessels are complete with underdrain, face piping, carbon transfer piping, and sample/instrument connections. The system is owned by Calgon Carbon Corporation and is provided to customers on a service basis. When the service agreement is complete, contact Calgon Carbon for information on returning the High Flow Dual Module system. Because the system is owned by Calgon Carbon, major maintenance items are the responsibility of Calgon Carbon.

After assembling the system and connecting the influent and effluent piping, the vessels may be operated in parallel configuration or individually.

Granular activated carbon will be delivered to the site in Calgon Carbon Corporation's bulk trailers for unloading directly as a water slurry into an empty adsorber.

The stream to be treated is pumped to the adsorption system at a flow rate compatible with the design capacity of the unit. The adsorption system is operated in parallel configuration.

Initially, the impurities are adsorbed onto the carbon in the upper portion of the bed. As this top layer of carbon becomes saturated, adsorption takes place lower in the bed. Eventually all the carbon in the adsorber becomes saturated and the contaminant concentration of the effluent from the adsorber increases until it approaches or equals the influent concentration.

When the carbon in a vessel is exhausted, an empty trailer is sent to the site to remove the load of spent carbon. Pending completion of carbon acceptance by Calgon Carbon, the carbon will be returned to one of our plant sites for thermal reactivation.

In some cases, a transfer tank may be provided as part of the Dual Module installation.

This tank is sized to hold 20,000 pounds of spent carbon, which is an amount equal to one charge of carbon from an adsorber. This tank is provided to facilitate carbon transfer operations and eliminates the need for, and costs associated with, an empty bulk trailer. Calgon Carbon's triple compartment trailer can also be used to accomplish the same effect (refer to Section 4.0 for details on the triple compartment trailer).

The spent carbon is transferred from the adsorber to the bulk trailer by first filling the adsorber with water. The adsorber is then pressurized using compressed air as the motive force to facilitate the carbon transfer to the trailer.

Once the spent carbon transfer operation is completed, a charge of fresh carbon can be transferred into the empty adsorber. This is accomplished by filling the bulk trailer with



water and placing a water cushion in the adsorber. The bulk trailer is then pressurized with compressed air to facilitate the carbon transfer into the adsorber.

In parallel operation, the influent flow is directed to both vessels through a common inlet line. When contaminant breakthrough is detected from one or both vessels, the system is shut down for carbon replacement. If breakthrough occurs from only one bed, it is possible for the other adsorber to remain on-stream at its normal or a slightly higher flow rate. However, this is normally not done and both carbon beds are replaced. Parallel operation is used in situations where the carbon usage rate is low, the mass transfer zone is short, and/or the flow rate is high.

Pressure gauges are provided to measure the pressure drop across each bed. Pressure drop through an adsorber system is a function of many factors:

1. Pressure drop through the carbon bed(s).
2. Nozzle and piping pressure drop.
3. Mode of operation (series or parallel).
4. Flow rate, viscosity, and density of the liquid.
5. Solids build-up on top of the bed.
6. Bacteria growth or chemical precipitation in the bed.
7. Gas build-up in the bed.

Backflushing is usually required when the pressure drop across an adsorber increases by 5 to 10 psi during the adsorption cycle.

To prevent damage to the system in the event that the pressure limitation of the vessels is exceeded, rupture disks are provided in the adsorber vent lines. Calgon Carbon's standard rupture disk is a graphite disk with a 75% recommended operating ratio, which means that an operating pressure higher than 75% of the disk's burst pressure will begin to stress the disk.

After startup, records should be kept of pertinent data such as flow rate, pressure drop across each bed, total dissolved solids, temperature, pH, toxicity, BOD, COD, and organic contaminant levels.



2.0 INSTALLATION

In addition to the instructions below, refer to the Appendix of this manual for Calgon Carbon's Specification 7209A-VS13 on shipping and handling of liquid phase systems for more details.

2.1 UNLOADING/FOUNDATIONS

Before any assembly, inspect all of the equipment for any damage that may have occurred during shipment. Check the bill of materials against the items delivered to ensure that all of the equipment is at the site.

The equipment can be set on a permanent or temporary foundation. A gravel base with timbers or railroad ties is adequate for a temporary installation on suitable soil. Any foundation, either temporary or permanent, must be adequate to support the operating weight of the unit.

Before installation of a permanent system, the adsorber tanks should be oriented on the foundation to ensure that the inlet and outlet opening and anchor lugs are positioned properly. The outline of the adsorbers, including lug positions, should be marked on the foundation. The equipment should be oriented for easy access to the carbon transfer connections from a bulk trailer.

2.2 EQUIPMENT INSTALLATION

The system will be shipped to the site as two skid-mounted vessels, with a separate valve manifold assembly. A crane is required to off-load the skids and valve assembly. Lifting lugs are provided. A properly trained and experienced rigging crew should be employed to set the equipment. The two vessel skids should be set on the foundation in a level position and the base frames connected. They should then be anchored as required by local codes and seismic regulations.

See the Specifications section (Section 1.1) for the shipping weight of the system. Once the skids are set in place, the valve manifold assembly may be installed and the influent and effluent piping connected. Customer supplied piping to the High Flow Dual Module system should include an anti-syphon loop on the effluent or adequate backpressure to ensure that the water level in the adsorbers covers the carbon bed during operation (see section 3.5).



3.0 OPERATION

3.1 PRE-OPERATION CHECK-OUT

All equipment and systems affiliated with the granular carbon adsorption system such as pumps, filters, etc. should be checked out according to the manufacturer's instructions. Specific activities to complete before operating the adsorption equipment should include the following:

1. Check all piping connections for proper installation and tightness.
2. Ensure that all gauges and instruments are functional and installed correctly. Re-zero or re-calibrate if necessary.
3. Close all valves in the adsorber piping system.
4. Install the carbon acceptance canister (if provided) after checking to ensure it is filled with carbon.

For potable water treatment installations, the customer will be responsible for cleaning and disinfecting the vessels and piping prior to filling the system with carbon. The procedures to complete this step in the installation process are the responsibility of the customer.

3.2 FILLING AN ADSORBER WITH CARBON

After the system has been checked, the adsorbers are ready to be filled with granular activated carbon. The carbon is transferred to the adsorbers as a water slurry from Calgon Carbon trailers. The detailed procedures for making the transfer are given in Section 4.3.

The trailer driver connects the necessary hoses and operates all the valves on the trailer. A plant operator should be available to operate the valves on the adsorber skid.

After all the carbon is transferred from the trailer, the driver disconnects the hoses and closes the valves on the trailer. The plant operator closes the valves in the vent and carbon fill lines on the adsorber.

3.3 WETTING (DEAERATING THE CARBON)

In a typical bed of virgin carbon, the pore volume is approximately 40% of the bed volume. Carbon which is shipped dry will contain air in these pores. Therefore, the carbon must be properly wetted prior to being placed on stream. If this is not done, the air within these pores will displace into the void spaces between the carbon particles during operation and cause high pressure drop and channeling in the adsorbers. These problems can cause premature breakthrough of contaminants. Air will not migrate out of the bed during normal downflow operation.



The time required for wetting is a function of liquid temperature and viscosity. Generally, a minimum wetting period of 24 hours is required using water at ambient temperatures, although a period of up to 72 hours is preferred for complete wetting. As an alternative, the Calgon Carbon Service trailer containing fresh carbon may be filled with water and allowed to stand for several hours before transferring the carbon to the adsorber.

After the carbon has been wetted, the adsorber should be drained and then backfilled until water flows out the vent line. The adsorber should be filled up-flow at 4 gpm/ft², maximum. For a Dual Module system this is 300 gpm, maximum.

If the unit must be placed on-stream before the carbon has been wetted, the adsorbers should be drained and backfilled when the pressure drop becomes prohibitive or after two days of operation, whichever occurs first.

For process applications, the same procedure is required. If the process liquid cannot be diluted with water and the carbon must be wetted with the process liquid there will be a significant heat of adsorption. In this case, Calgon Carbon should be contacted for specific instructions on the method to be used for wetting.

3.4 BACKFLUSHING

3.4.1 BACKFLUSH - GENERAL

Backflushing is a procedure involving running clean, contaminant-free water upflow through the adsorber. Backflushing of a carbon bed can be done after fresh carbon has been transferred into an adsorber and wetted, or during operation to remove sediment from the top of the bed. Backflushing can be used to remove fines from the upper portion of the bed. This operation will not remove fines from the lower portion of the bed because it does not expand the bed. Expansion of the bed allows the fines at the bottom of the bed to move to the top. However, fines do not always cause high pressure drop, and their removal is not always necessary.

The backflushing rate is 2 to 3 gpm/ft² and this is not significant enough to expand the carbon bed. For the Dual Module adsorber this is a flow rate from 150 gpm to 225 gpm. Flow rates of less than 300 gpm will not expand the bed; therefore, size segregation of the bed will not occur. The time required for backflushing is 30 to 45 minutes.

Normally when backflushing, a clean external water source is used. The stream should be compatible with the system and free of suspended solids and organic contaminants which might affect adsorption. If necessary, effluent from the adsorber system may be used as the water source.



When normal downflow operation is started after backflushing, the initial 5 to 15 minutes of effluent flow will be dark due to a small quantity of fines. Under normal operating conditions, this condition will clear up.

3.4.2 BACKFLUSHING AN ADSORBER

In this mode, a clean external source is used as the source for the backflush water. Note that the lead adsorber is taken out of service while the backflushing procedure takes place. This sequence applies to a series operated system, with the lag adsorber remaining on-line during the backwash. For a system operating in parallel, both beds should be taken off-line when backflushing is required.

1. Isolate the adsorber to be backflushed. If adsorber PV1 is to be backflushed, refer to Section 3.6.4 for valve sequencing. If adsorber PV2 is to be backflushed, refer to Section 3.6.6 for sequencing.
2. Open valve V3 for PV1 (valve V7 for PV2).
3. Open the vent valve (V10 for adsorber PV1, V11 for adsorber PV2).
4. Connect a backflush water source to the 3" drain line.
5. Open drain valve V9.

The backflush water enters the vessel through the effluent line and flows up through the underdrain and the carbon bed. The backflush water discharge from the vent line should be observed for clarity to determine the duration of backflushing. Fresh carbon fills may be backflushed before bringing the system on-line.

3.4.3 RESTARTING SYSTEM AFTER BACKFLUSHING

The valve sequence given below describes the steps taken to bring a system on-line after backflushing. The valve numbers refer to bringing adsorber PV1 back on-line in the lead position. Valve numbers applying to placing adsorber PV2 back in the lead position are in parentheses.

1. Close drain valve V9 and disconnect the backflush water source from the adsorber drain line.
2. Close valve V10. (V11) Leave V3 (V7) open.
3. Open cross-over valve V6. (V2)
4. Open influent valve V1. (V5)
5. Close influent valve V5. (V1)

3.5 STARTUP

3.5.1 SERIES FLOW



The adsorber system is normally operated in a series mode. Valves in the influent and effluent lines are opened or closed, as required, to set the operation of the carbon vessels in the desired configuration. The first bed in the system is called the lead bed. The second bed is referred to as the polish or lag bed.

The following sequence of steps should be followed to bring an adsorption system on-line in the series mode:

1. Place the feed pump (s) in service to supply the adsorption module at the required flow and pressure.
2. Check that all the valves in the adsorption system are closed.
3. Open the valve in the effluent line from the polish adsorber (either V4 or V8).
4. Open the valve in the cross-over influent line to the polish adsorber (either V6 or V2).
5. Open the valve in the cross-over effluent line from the lead adsorber (either V3 or V7).
6. Start the feed pump and open the valve in the pump discharge line.
7. Slowly open the valve in the influent line to the lead adsorber (either V1 or V5) and allow the pressure to increase to the operating level.

At this point, flow should be established downflow through both vessels and they will be on-line in series.

Set the flow rate to the system at the desired value after flow is established to the unit. Flow control meters, totalizers, and control instrumentation will be provided by the customer as required for the system.

In order to obtain full utilization of the carbon and prevent air entrapment and channeling in the bed, the water level must remain above the carbon bed. To prevent the bed from draining due to gravity or loss of influent supply, a vacuum break (anti-syphon) loop or backpressure should be included by the customer in the effluent piping. This start-up sequence assumes that an anti-syphon loop is present in the effluent piping. If no anti-syphon loop or backpressure is present, start the system by starting the pump and opening the valves in the opposite order of the sequence given previously (i.e. open the influent valve first, followed by the cross-over valves and effluent valve).



3.5.2 PARALLEL FLOW

The following sequence of steps should be followed to bring an adsorption system on-line in the parallel mode:

1. Place the feed pump (s) in service to supply the adsorption module at the required flow and pressure.
2. Check that all the valves in the adsorption system are closed.
3. Open the valves in the effluent lines from the adsorbers (V4 and V8).
4. Start the feed pump and open the valve in the pump discharge line.
5. Slowly open the valve in the influent line to one adsorber (either V1 or V5) and allow the pressure to increase to the operating level.
6. Slowly open the valve in the influent line to the other adsorber (either V1 or V5) and allow the pressure to increase to the operating level.

At this point, flow should be established downflow through both vessels and they will be on-line in parallel.

Set the flow rate to the system at the desired value after flow is established to the unit. Flow control meters, totalizers, and control instrumentation will be provided by the customer as required for the system.

In order to obtain full utilization of the carbon and prevent air entrapment and channeling in the bed, the water level must remain above the carbon bed. To prevent the bed from draining due to gravity or loss of influent supply, a vacuum break (anti-syphon) loop or backpressure should be included by the customer in the effluent piping. This start-up sequence assumes that an anti-syphon loop is present in the effluent piping. If no anti-syphon loop or backpressure is present, start the system by starting the pump and opening the valves in the opposite order of the sequence given previously (i.e. open the influent valves first, followed by the effluent valves).

For parallel operation, flow is established to each vessel by opening the valves as indicated previously. Changing the flow to one vessel may result in a flow change to the other vessel on the skid. This occurs because the vessels share a common influent and effluent line. Flow meters can be installed in the individual influent lines to each vessel to balance the flow to each unit if required.



3.6 STEADY STATE OPERATION

Once flow is established to both vessels and the flow rate is set, no further adjustments are made during normal operation. The operator should establish a routine to check the adsorbers and to collect operating data. This data can be used to establish a maintenance schedule, to determine when backflushing is necessary, or to determine when fresh carbon is needed.

3.6.1 MONITORING

Sample connections are provided on the influent and effluent lines from each vessel to take periodic samples for analysis.

Pressure gauges are provided to determine the pressure drop across each carbon bed. Taking periodic pressure readings will provide the operator with historic data for troubleshooting purposes. In the event that operating conditions change, the operator has the capability of taking corrective action.

3.6.2 VALVE OPERATION

All valves should be operated in a slow and even motion. Abrupt opening and closing of the valves can shock the system. Since complete shut-off of flow while a pump is operating could cause damage to the pump, the valves should be operated in the proper sequence in order to always maintain flow through the system. If the vessels are identified as PV1 and PV2 then the corresponding valve positions during adsorption are given as follows:

<i>Process Valve Number</i>	<i>Series PV1 to PV2 (Figure 1)</i>	<i>PV2 Single Operation (Figure 2)</i>	<i>Series PV2 to PV1 (Figure 3)</i>	<i>PV1 Single Operation (Figure 4)</i>	<i>Parallel Operation (Figure 5)</i>
V-1	Open	Closed	Closed	Open	Open
V-2	Closed	Closed	Open	Closed	Closed
V-3	Open	Closed	Closed	Closed	Closed
V-4	Closed	Closed	Open	Open	Open
V-5	Closed	Open	Open	Closed	Open
V-6	Open	Closed	Closed	Closed	Closed
V-7	Closed	Closed	Open	Closed	Closed
V-8	Open	Open	Closed	Closed	Open

Single stage operation occurs for short time periods, such as during carbon transfer or backflushing of the lead bed, or during other routine maintenance on one of the



adsorber vessels. **NOTE: FLOW SEQUENCE CHANGES (AS DESCRIBED IN THE FOLLOWING SECTIONS) SHOULD BE PERFORMED ONLY WHEN CARBON CHANGEOUTS, BACKFLUSHING, OR OTHER VESSEL MAINTENANCE IS REQUIRED.**

3.6.3 ADSORBER SEQUENCING: PV1 LEAD, PV2 LAG

This sequence should be used to start up the system in series mode from PV1 to PV2. Refer to Section 3.5.1 for additional details.

Starting valve position: All valves closed.

- Open valve V8
- Open valve V6
- Open valve V3
- Open valve V1

At this point, flow should be established from PV1 to PV2.

3.6.4 ADSORBER SEQUENCING: TAKING ADSORBER PV1 OFF-LINE

When adsorber PV1 is taken off-line for carbon transfer or backflushing, all of the process flow should be sent through adsorber PV2.

Starting valve position: Series flow from PV1 to PV2.

- Open valve V5
- Close valve V6
- Close valve V3
- Close valve V1

Flow should now be established through adsorber PV2 with adsorber PV1 off-line for carbon transfer or backflushing.



3.6.5 ADSORBER SEQUENCING: PV1 BACK ON-LINE AS LAG VESSEL

After adsorber PV1 is filled with fresh carbon, it should be placed on-line in the polish position, with adsorber PV2 moved to the lead position.

Starting valve position: Single stage flow to PV2.

- Open valve V7
- Open valve V2
- Open valve V4
- Close valve V8

Flow should now be established from adsorber PV2 into adsorber PV1.

3.6.6 ADSORBER SEQUENCING: TAKING ADSORBER PV2 OFF-LINE

When adsorber PV2 is taken off-line for carbon transfer or backflushing, all of the process flow should be sent through adsorber PV1.

Starting valve position: Series flow from PV2 to PV1.

- Open valve V1
- Close valve V2
- Close valve V7
- Close valve V5

Flow should now be established through adsorber PV1 with adsorber PV2 off-line for carbon transfer or backflushing.

3.6.7 ADSORBER SEQUENCING: PV2 BACK ON-LINE AS LAG VESSEL

After adsorber PV2 is filled with fresh carbon, it should be placed on-line in the polish position, with adsorber PV1 moved to the lead position.

Starting valve position: Single stage flow to PV1.

- Open valve V3
- Open valve V6
- Open valve V8
- Close valve V4

Flow should now be established from adsorber PV1 into adsorber PV2.



3.6.8 ADSORBER SEQUENCING: PARALLEL OPERATION

The following sequence should be used to start up the system in parallel mode. Refer to Section 3.5.2 for details.

Starting valve position: All valves closed.

- Open valves V4 & V8
- Open valves V1 & V5

Flow should now be established through the system in parallel. When carbon transfer or backflushing is required, the system should be shut down until the operation is complete.

3.7 SHUTDOWN

3.5.1 SHORT TERM SHUTDOWN

For short duration shutdowns lasting less than one or two weeks, little needs to be done. Close all valves in the adsorber piping system, and open the vent line valves on each vessel. The feed pumps should be shut down and the valves closed in the lines to and from the pumps. Any drain valves in the pump casing should be opened for the duration of the shutdown. Freeze protection measures such as draining lines at the low points should be taken when there is a chance of freezing. Freeze protection measures are usually the responsibility of the client.

3.5.1 EXTENDED SHUTDOWNS

For extended shutdowns, in addition to the steps in Section 3.7.1, the adsorbers should be drained of all water and filled with clean plant water.

When the adsorbers are started up again, the carbon beds may require disinfection. If disinfection is required, the procedures to disinfect a carbon bed can be found in the Appendix of this manual. Once the disinfection is complete, backflush the adsorbers prior to startup.

After disinfection, bring the adsorber back on-line in the downflow mode, monitor the effluent for coliform count and monitor the pressure drop.



3.8 TROUBLESHOOTING GUIDE

PROBLEM		PROBABLE CAUSE		REMEDY
High pressure drop across adsorber.	1.	Bed not flooded. Bed is air bound.	1.	Open vent valve or carbon inlet valve to release pressure. Add water upflow to fill vessel. Establish constant forward flow, then close valve.
	2.	High feed pump pressure.	2.	Throttle feed pump.
	3.	High suspended solids loading or carbon fines around the nozzles.	3.	Test feed for suspended solids. Install influent filter. Backflush the adsorber.
	4.	Improper valve settings.	4.	Check valve sequence.
Leaking flange.	1.	Loose bolts.	1.	Tighten bolts.
Excessive flow out vent line.	1.	Broken rupture disk.	1.	Check the following conditions before replacing disk: 1) Check downstream valving to make sure that the system is not plugged off. 2) Check feed pump pressure to make sure it is not too high. 3) Check process valve sequence. 4) Check that excessive pressure build-up did not occur in closed vessels during extended shutdowns. Once the potential source of overpressurization is removed, replace rupture disk.
Carbon in the effluent.	1.	Internal mechanical (i.e. underdrain) failure.	1.	Check for carbon in the effluent to confirm. Determine which adsorber is causing the problem, then remove carbon and make repairs.
Sudden high contaminant concentration in effluent.	1.	Carbon heel from improper transfer.	1.	Wait until contaminant flushes out. Review transfer procedures.
	2.	Leaking valve.	2.	Repair/replace valve.
	3.	Mass transfer zone has	3.	Replace carbon.

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PROBLEM		PROBABLE CAUSE		REMEDY
		extended into effluent.		
Premature breakthrough of organics in the effluent.	1.	Influent concentration change.	1.	Confirm by analyzing effluent sample(s) before changing carbon.
	2.	Air in the influent stream.	2.	Open vent valve and fill bed upflow with water as required.
	3.	Background TOC or colloids present.	3.	Change carbon.
	4.	Leaking valves.	4.	Check operation of valves in influent and effluent lines.
	5.	Incorrect valve sequence.	5.	Sequence the flow through the system properly.
Carbon heel in empty vessel.	1.	Insufficient rinse water.	1.	Provide additional rinse water flow.
	2.	Mechanical failure.	2.	Check vessel internal parts and make repairs.
	3.	Foreign material on the carbon.	3.	Rinse vessel to remove carbon.



4.0 CARBON TRANSFER PROCEDURE - STANDARD TRAILER

The procedures that are detailed in this section of the manual are for Calgon Carbon's standard carbon trailer. Carbon may be delivered in any of three types of trailers; the standard trailer, the lift (dump) trailer, or the triple compartment trailer. The procedures for loading or unloading carbon are similar for all three units, but there are some slight differences.

The lift trailer (Figure 7) is a high pressure unit and can be operated at pressures as great as 35 psig. This unit is used when the adsorbers are elevated or when they have long straight sides. For these cases, higher pressure is required to deliver carbon to the top of the vessels. This trailer requires an overhead clearance of 26' because the tank portion is elevated before the start of carbon transfer.

The procedural difference between the standard trailer and the lift trailer is that the lift trailer is pressurized to 30 psig when fresh carbon is transferred from the trailer to the adsorber.

The triple compartment trailer (Figure 8) is built to hold 10,000 pounds of carbon in each end section and 20,000 pounds in its center section. The triple compartment trailer arrives at the site with fresh carbon in the end sections. First, spent carbon is transferred to the center section of the trailer, then the fresh carbon is transferred from the end compartments to the adsorber.

Some Dual Module installations include a carbon transfer tank to facilitate carbon transfer operations. This tank is sized to hold a 20,000 pound load of activated carbon. The carbon transfer procedures included in this manual do not include instructions involving a transfer tank. A separate carbon transfer procedure section will be shipped with the transfer tank when the tank is included in the Dual Module supply. If your installation includes a transfer tank, but no carbon transfer procedures are included with the tank, contact Calgon Carbon Corporation.

In cold weather conditions, steam may be used to thaw the trailer and transfer lines if necessary. Contact Calgon Carbon for trailer steaming procedures if required.



4.1 SITE REQUIREMENTS

A flat paved area is needed to support the Calgon Carbon service trailer which may weigh up to 100,000 pounds. The overhead clearance required for the adsorption system is 13 feet. A diagram of the trailer and its on-board piping is shown in Figure 6.

The utility and piping requirements to connect to the adsorber and trailer are as follows:

Adsorber

Plant air line	1" female Kamlock connection 100 scfm at 30 psig min. (Attaches to 1" compressed air connection on vent line) -OR- 3/4" female Kamlock connection 100 scfm at 30 psig min. (Attaches to 3/4" flush connection on carbon fill line above carbon inlet valve)
Plant water line	2" female Kamlock connection 100 gpm (max) at 30 psig min.

Trailer (See Figure 6)

Plant air line	3/4" female Kamlock connection (for both industrial & food grade trailer) 100 scfm regulated to 15 psig max.
Plant water line	4" Kamlock connection (female for industrial trailer, male for food grade trailer) 100 gpm regulated to 15 psig max. (Connect to Trailer Carbon Fill or Discharge Line)



4.2 SPENT CARBON TRANSFER TO TRAILER

Spent carbon transfer from the adsorber to the trailer is accomplished by pressurizing the adsorber with plant air. When the transfer is complete, the spent carbon in the trailer is drained of water. Prior to disconnecting any lines, the air supply must be shut off, and the adsorber and all transfer lines must be vented.

4.2.1 SPENT CARBON TRANSFER

A. Prepare for Spent Carbon Transfer:

1. Close all adsorber valves.
2. Connect the adsorber carbon outlet line to the trailer carbon fill line using 4" flexible hose.
3. Open the center manway of the trailer or trailer vent valve T1 for venting.
4. Open valve T2 in the trailer carbon fill line.
5. Check that the adsorber is full of water.
6. To aid the initial phase of transferring spent carbon, fill the transfer line with water. To do this, use a 3/4" water hose to fill the transfer line with water at the adsorber carbon outlet valve's flush-out connection.

B. Transfer Spent Carbon

1. Open the air line valve slowly and pressurize the adsorber to 25 to 30 psig.
2. Open the 4" adsorber carbon outlet valve and transfer the spent carbon to the trailer.
3. As the trailer starts to fill with carbon slurry, open trailer septa valves T8, T9, and T10 to drain off excess motive water.

The transfer should take 20 to 30 minutes. The transfer will end with a loss of pressure in the adsorber and the sound of air in the transfer line.



C. Heel Removal

It will be necessary to add a small amount of water to the adsorber to ensure that all of the spent carbon has been removed from the adsorber. During the last five minutes of the transfer, open the 2" plant water valve. This flow of water will flush the carbon heel off the sides of the adsorber and into the bottom of the vessel.

D. End Transfer

1. Close the plant air line valve.
2. Vent the tank and lines through the trailer vent valve T1.
3. Open the adsorber vent valve (V10 or V11) to further aid the venting.
4. Close the adsorber carbon outlet valve.
5. Using a 3/4" water hose at the adsorber carbon discharge line flush-out connection, flush out the transfer line for a few minutes to remove all traces of carbon. Bleed the water hose and remove it.

4.2.2 DRAIN WATER FROM TRAILER

A. Prepare for Draining Water

1. Close all valves on the trailer. Close the trailer manway.
2. Connect the plant air line to the 3/4" connection on trailer carbon fill line using the air line hose.
3. Connect the trailer carbon discharge/drain line to the drain line in the trench by means of a 4" flexible hose.

B. Draining Trailer

1. Pressurize the trailer to 15 psig by slowly opening plant air line valve T4 on the trailer.
2. Open 2" trailer septa valves T8, T9, and T10.

By pressurizing the trailer, water will be drained in less time than if drained by gravity.

C. End Draining



1. When the carbon is completely drained, close the air line valve T4 on the trailer.
2. Vent trailer slowly through trailer vent valve T1.
3. When venting is complete, close all valves on the trailer and disconnect all hoses.

The trailer is now full of drained spent carbon and is ready for return to Calgon Carbon for reactivation.

4.3 FRESH CARBON TRANSFER FROM TRAILER

Fresh carbon is transferred in a slurry using plant air pressure. The trailer is first filled with water to create the slurry. The carbon slurry hose on the trailer is connected to the adsorber fill line and the trailer carbon discharge line. After putting a water cushion in the adsorber, the trailer is pressurized and the carbon slurry is transferred to the empty adsorber. Prior to disconnecting any lines, the air supply must be shut off, and the trailer and all transfer lines must be vented.

Under no circumstances should the standard and triple compartment trailers be connected to a pressure source exceeding 15 psig.

4.3.1 FILL THE TRAILER WITH WATER

If the carbon is wetted prior to delivery, about 4000 gallons of water will be required. If the carbon is dry, about 5000 gallons of water will be required. The trailer may be filled upflow or downflow.

A. Filling Operation

1. Connect water line to the trailer (carbon fill line if filling downflow, carbon discharge line if filling upflow) using a 4" flexible hose.
2. Open one top manway to vent trailer during filling.
3. Open trailer vent line valve T1.
4. Open trailer water line valve (valve T2 if filling downflow, valves T8, T9, and/or T10 if filling upflow).
5. Open plant water line valve slowly and fill the trailer.



The trailer will be filled with approximately 4000 to 5000 gallons of water. The trailer filling shall be visually determined by observing the water level through the manway or by metering the desired amount.

B. End Filling Operation

1. Close plant water line valve.
2. Close trailer water line valve (T2 for downflow, T8, T9, and T10 for upflow), manways, and trailer vent valve T1.
3. Disconnect hose.

4.3.2 TRANSFER CARBON TO ADSORBER

A. Prepare for Transfer

Place about 2000 gallons of water in the adsorber. This water cushion helps to protect the underdrain system and vessel lining.

1. Connect the adsorber fill line to the trailer carbon discharge/drain line using 4" flexible hose.
2. Connect the 3/4" plant air line to the trailer carbon fill line using the air line hose.
3. Close all valves on the adsorber.
4. Open the adsorber vent valve (V10 or V11).
5. To aid the initial phase of transferring fresh carbon, fill the transfer line with water. To do this, use a 3/4" water hose to fill the transfer line with water, at the carbon inlet valve's flush-out connection.

B. Transfer Fresh Carbon

1. Pressurize the trailer to 15 psig by slowly opening the plant air line valve and then slowly opening valve T4 in the trailer carbon fill line.
2. Open the adsorber carbon fill line valve.
3. The Calgon Carbon trailer driver will open the trailer carbon outlet valves T5, T6, and T7 to empty the respective hoppers.



4. If a water cushion is utilized, open an adsorber drain valve shortly after starting the transfer. This is done to reduce the amount of water that overflows at the end of the transfer. The disposal of the excess motive water is provided by the customer.

C. End Transfer

1. Close the plant air valve and vent the trailer through the adsorber vent valve.
2. Close the adsorber drain valve if it was utilized during the transfer.
3. Slowly open trailer vent valve T1 for additional venting.
4. When completely vented, close the adsorber fill line valve, disconnect the hoses, and close the trailer valves.
5. Refer to Sections 3.3 and 3.4.2 for instructions on wetting and backflushing the adsorber.
6. After the adsorber has been backflushed, shut off the plant water and close the vent valve on the adsorber.



5.0 GENERAL INFORMATION

5.1 MAINTENANCE

Because the Dual Module system is owned by Calgon Carbon and is used under a service agreement, any major maintenance items should be performed or supervised by Calgon Carbon personnel. Minor maintenance items such as visual checks of pressure gauges, adjustments to valves and regulators, tightening flanges and connections to eliminate leakage, replacement of rupture disks, etc., may be completed by the customer.

As preventative maintenance, periodic inspection of the vessel internal parts should be made to ensure that the underdrain, vessel lining, and nozzles are in good condition. As a minimum, each adsorber should be inspected once per year, or during carbon transfers if the on-line period exceeds one year. Any nozzles showing signs of fatigue or surface area restriction due to pluggage of the nozzle slots should be replaced. Nozzles should be physically checked to ensure that they are tightly secured.

Systems with high backwash frequencies and rigorous backwash requirements should be inspected more frequently. The vessels must be fully emptied to allow inspection of the interior of the vessel. Follow the safety guidelines listed in the following sections when entering enclosed vessels. Calgon Carbon Operations personnel should be present during internal vessel inspections.

Pressure gauges have been installed to determine the pressure drop across each carbon bed. Taking periodic pressure readings will give the operator the capability of monitoring the pressure drop across the carbon vessels over time. If a pressure increase is observed, then corrective action can be taken before the pressure drop becomes a problem.

In order to protect the vessel from high pressure, a safety device is provided. Usually, this device is a rupture disk or pressure relief valve. The rupture disk is designed to rupture within 5% of the disk's stamped burst pressure. However, repeated pressure swings above the operating ratio pressure (75% of the burst pressure for Calgon Carbon's standard graphite rupture disk) can cause premature bursting of the disk.



5.2 SAFETY CONSIDERATIONS

5.2.1 OXYGEN DEMAND DUE TO ACTIVATED CARBON

Studies have shown that low oxygen content exists in vessels containing wet drained granular activated carbon. The laboratory experiments conducted since that time also have revealed that commercial activated carbons in a wet or moist condition will lower the oxygen content of an isolated space.

Preliminary indications of this research are:

- 1) The phenomenon occurs with all types of wet activated carbon.
- 2) The rate of oxygen uptake naturally varies with the degree of exposure of the wet carbon to the air. Thus, it is relatively rapid in a drained bed.
- 3) There is some indication of a limit to the carbon's capacity for oxygen, but until more is known, it would be prudent to assume that all carbons (fresh, used, reactivated) will also exhibit this characteristic. Similarly, although these tests were run with water, it should be assumed that the phenomenon will occur in other liquid and vapor systems.

Based on the properties of wet activated carbon, a confined space entry procedure should be established for any facility using carbon in confined vessels.

All confined spaces, including those containing activated carbon, should be presumed to be hazardous. Appropriate safety measures should always be taken before entering, as well as when workers are in a confined space. OSHA regulations applicable to respiratory protection in oxygen deficient atmospheres should be strictly adhered to.

5.2.2 EMERGENCY PROCEDURES

In the event a malfunction which causes a shutdown of an adsorber should occur, the flow can either be switched to the second adsorber in the system or the flow can be stopped.

If a major leak or similar problem develops, flow to the adsorber should be stopped immediately and steps taken to correct the problem. Proper safety procedures should be observed at all times to prevent damage to the equipment or injury to personnel. Calgon Carbon should be contacted before any emergency maintenance on the system is performed.



5.2.3 PRESSURE RELIEF WARNING

TO AVOID VESSEL DAMAGE AND ENDANGERMENT OF OPERATING PERSONNEL, DO NOT BLOCK THE PRESSURE RELIEF DEVICE FROM VENTING TO ATMOSPHERE.

5.3 RECORD KEEPING

Normally, operating data is taken for: 1) flow rates, 2) which beds are in service, 3) pressure drop across each unit, and 4) necessary analytical work for influent and effluent to each adsorber. This may include: pH, TOC level, BOD, COD, toxicity, organic contaminant levels, and inorganic levels



6.0 ACTIVATED CARBON/ADSORPTION INFORMATION

6.1 GLOSSARY

The following terms are commonly used to describe adsorption theory, activated carbon, and adsorption systems.

Abrasion Number - A test performed on a particulate material to define the resistance of the particles to degrade on handling. It is calculated by contacting a sample with steel balls in a Ro-Tap machine and determining the ratio of the final to the original mean particle diameter.

Activated Carbon - A carbonaceous material that is a crude form of graphite with a random and amorphous structure. The structure is highly porous, over a broad range of pore sizes, from visible to molecular cracks and crevices.

Acid Washed Activated Carbon - Activated carbon which has been washed with an acid solution for the purpose of dissolving the iron from the carbon. Acid washed carbons are usually used in systems/processes operating at low pH.

Adsorbate - Any substance that is or can be adsorbed on the adsorbent.

Adsorbent - Any solid having the ability to concentrate significant quantities of other substances on its surface. Activated carbon is an adsorbent.

Adsorber - A vessel designed to hold granular activated carbon.

Adsorption - A phenomenon where an adsorbate is physically attracted to the surface of the adsorbent.

Adsorption Isotherm - A graphic depiction of the capacity of an adsorbent to adsorb a specific adsorbate. The measurements of capacity are performed at constant temperature using either varying amounts of the adsorbate or adsorbent.

Adsorption Pores - The finest pores in the carbon structure. Pores which have adsorption capacity.

Air Scouring - A process that uses pressurized air to break-up any agglomerations in a carbon bed. Air is blown into the bottom of the bed before the bed is backwashed. Air scouring capability must be incorporated into the system design during the design phase.

Apparent Density - A physical property that is defined as the mass per unit volume of a granular material under specified conditions. The apparent density includes the carbon skeleton volume plus the pore and void volumes.



Ash - The noncombustible mineral matter that is contained in activated carbon and is the residue that remains after the combustion of a carbonaceous material. The measurement of ash is performed under specified conditions and is normally defined on a weight percent basis.

Backwash - An operating method used to remove suspended solids from a carbon bed. Water is pumped into the bottom of the adsorber, flows upward through the carbon bed, and exits through the backwash outlet. The upward flow expands the bed and removes carbon fines, entrained air and suspended solids. The percent bed expansion (up to 50%) and time required for backwashing are a function of the backwash rate and water temperature.

Backflush - A process similar to backwashing, but the flow rate is not high enough to expand the bed more than five percent.

Carbon Heel - Any quantity of spent carbon not removed from an adsorber before recharging the vessel with fresh carbon.

Carbon Tetrachloride Activity - A measurement of the increase in weight of a sample of activated carbon after air saturated with carbon tetrachloride is passed through the sample. The test is performed at a given temperature and the results are reported as weight percent.

Carbon Trailer - A bulk trailer used to transport 20,000 pound (or less) loads of granular carbon to/from the customer's plant site.

Chemisorption - A chemical process that binds an adsorbate to the surface of an adsorbent by forces whose energy levels approximate those of a chemical bond.

Color Bodies - Complex molecules which impart color (usually undesirable) to a solution. Carbon adsorption is often used for color removal applications.

Counter-current Operation - A mode of operation where the flow of liquid is opposite the movement of the adsorbent. This method of operation produces the lowest carbon usage rate or highest efficiency.

Critical Bed Depth - The distance between the fresh carbon and the spent carbon for a bed of activated carbon. In other words, it is the portion of the bed which is partially spent and the zone where adsorption takes place. The critical bed depth is measured in feet. For a single column system, this is the amount of carbon that is not completely utilized when the effluent objective is reached and the carbon is taken off-stream.

Deaeration (Wetting) - The process of removing air (gases) from a carbon bed and the carbon pores. The volume of air in activated carbon is in the void space and pore volume, which typically accounts for 80% of the total volume in a carbon bed (the carbon skeleton accounts for the other 20%).



Desorption - The opposite of adsorption. A phenomenon where an adsorbed substance leaves the surface of the adsorbent.

Eductor - A device to motivate a slurry of activated carbon and water slurry through hoses and pipes. An eductor has no moving parts and utilizes pressurized water as the motive force.

Fresh Carbon - New carbon that is placed into an adsorber. Fresh carbon can be either virgin carbon or newly reactivated carbon.

Hardness Number - A measurement of the resistance of a granular carbon to the degradation action of steel balls in a Ro-Tap machine. This number is calculated by using the weight of granular carbon retained on a particular sieve after the carbon has been in vigorous contact with the steel balls.

Heat of Adsorption - The heat given off when molecules are adsorbed.

Iodine Number - The measurement of the amount of iodine adsorbed by one gram of carbon. The concentration of iodine is 0.02N. The iodine number is reported as milligrams of iodine.

Lag Adsorber - The second bed of carbon through which the liquid passes in a series operated adsorption system. The lag vessel contains carbon that is partially spent when the carbon in the lead adsorber is completely spent.

Lead Adsorber - The first bed of carbon through which the liquid passes in a series operated adsorption system. The lead vessel contains carbon that is the first to become spent.

Mass Transfer Zone - The adsorption gradient that exists in the carbon bed. It corresponds to the gradual transition of the carbon from spent to fresh.

Mesh Size - The measurement of the particle size of granular activated carbons determined by the U.S. Sieve Series. Particle size distribution within a mesh series is typically given in the specification of the particular Calgon Carbon carbon.

Molasses Number - A ratio of the optical densities of a molasses solution treated with a standard activated carbon compared to a molasses solution treated with the activated carbon in question.

Moisture - The measurement of the amount of water adsorbed on activated carbon. Moisture is reported as percent. For Calgon Carbon's coal based products the moisture specification is less than 2% as packed.

Parallel Flow - The mode of operation when two or more adsorbers are operated so that the



influent flow is distributed equally to each adsorber.

Particle Density - A measurement of the weight per unit volume of granular activated carbon as determined by the displacement of mercury. Particle density is typically reported as g/cc. The particle density includes the carbon skeleton volume plus the pore volume.

Polish Adsorber - See Lag Adsorber.

Pore Volume - A measurement of the volume of pores in a unit weight of carbon. The pore volume is determined by obtaining the difference in the volumetric displacement of carbon in mercury and helium at standard conditions.

Pressure Relief Device - A device such as a rupture disk or a pressure relief valve which prevents a vessel from exceeding its design pressure.

Real Density - A measurement of the weight per unit volume of the skeleton only of a carbon granule. This measurement excludes the pore volume and the inter-particle void space. This property is determined by helium displacement and is approximately 2.1 g/cc for coal based carbons.

Reactivated Carbon (React carbon) - Granular carbon that has been thermally reactivated for re-use as fresh carbon in adsorption systems.

Reactivation - A process to remove adsorbates from spent granular activated carbons using vaporization and oxidation at temperatures greater than 1000°F. Reactivated carbon can be reused. Depending on the application the performance of the reactivated carbon can be less than, equal to, or better than virgin carbon. This is a type of carbon regeneration.

Series Flow (Lead-Lag Operation) - A mode of operation where two or more adsorbers are operated so that each adsorber treats the entire influent flow, one after the other. When the carbon in the lead bed is spent, the carbon is replaced with fresh carbon and this adsorber is placed in the lag (polish) position.

Specific Heat - A physical property that is defined as the ratio of the quantity of heat required to raise the temperature of a compound through a particular temperature interval compared to the corresponding heat quantity for water. For Calgon Carbon carbons this value is approximately 0.20 cal/g/°C at temperatures less than 200°C.

Spent Carbon - Carbon that has adsorbed organic contaminants and must be removed from the system so that the effluent quality specifications are not exceeded.

Surface Area - A measurement of the total surface area available for adsorption inside the pores of activated carbon. Surface area is determined by the Brunauer, Emmett, and Teller method



(BET Method), which uses the adsorption of nitrogen at liquid nitrogen temperature. Surface area is usually expressed in square meters per gram of carbon. The surface area of Calgon Carbon carbons ranges from 700 to 1200 square meters per gram.

Transfer Tank - A storage tank designed to hold a charge of spent carbon. The purpose of the tank is to save on freight as only one truck is needed to deliver fresh carbon and return the spent carbon for reactivation.

Transport Pores - Pores larger than the largest adsorption pores. These pores function as a diffusion path to transport adsorbates. Adsorption does not occur in these pores even at saturated conditions.

Underdrain - A device located inside the adsorber to collect the fluid being treated. The underdrain permits the fluid to flow into the piping network while retaining the granular carbon in the vessel.

Vent - A pipe line from an adsorber or transfer tank to an unrestricted sewer or the atmosphere.

Virgin Carbon - Fresh granular activated carbon that has not been used.

Voids - The space (volume) between the carbon granules. For Calgon Carbon carbons the typical range is 37% to 43% by volume.

Water Cushion - The water added to an adsorber or transfer tank before charging the vessel with carbon. This is done to protect the underdrain, nozzles and lining.

Wave Front - See Mass Transfer Zone



6.2 ADSORPTION

There are two types of adsorption: chemical and physical.

Chemical adsorption is a chemical reaction between a molecule in a solution or vapor with the surface of an adsorbent such as activated carbon. The chemical reaction is usually irreversible. An example of chemical adsorption is chlorine removal from water. The chemical reaction of chlorine with carbon and water forms Cl^- and CO_3^{2-} ions.

Physical adsorption is usually explained in terms of surface structure (or energy per unit volume) of the solid. While molecules in the interior of any solid material are subject to equal forces in all directions, the molecules on the material's surface are subjected to unbalanced forces. This results in an imbalance with inward forces toward the solids. Molecules that are either gaseous or liquid then become attracted (adsorbed) to the solid's surface.

The attractive forces, known as London Dispersion Forces, are the same forces responsible for surface tension and condensation of vapors to liquid. These forces are a type of Van der Waals force and range from very weak to moderately strong. Physical adsorption is reversible and changing the process variables in a system can cause molecules to be desorbed.

An important aspect to any adsorbent is the amount of pore volume it contains per unit volume or per net weight. Examples of adsorbents are activated carbon, silica gel, activated gel, alumina, and zeolite.

6.3 ACTIVATED CARBON AND HOW IT WORKS

Any organic material with a high carbon content (coal, wood, peat, coconut shells, etc.) can be used as the raw material for making activated carbons of various activities and properties. When making high quality granular activated carbon from coal, the raw material is ground and a binder is added to give the end product suitable hardness. The mixture is then re-compacted and crushed to give it the desired particle size. The carbon is then activated by thermally decomposing and removing carbon from the structure in a reducing atmosphere at about 1800 F. Furnace temperature and the furnace atmosphere are controlled to produce the desired adsorption properties in the product.

The resultant product has an incredibly large internal pore volume per unit particle volume and a network of submicroscopic pores where the adsorption takes place. About 40% of the particle volume is used to contain adsorbates. One pound of activated carbon contains an effective total area of over 100 acres.

Activated carbon normally removes adsorbates (contaminants or desired products) from a solution (solute) through physical adsorption. The adsorbate would have to differ from the solute. For example, in aqueous solutions the solute should be more neutral or non-polar and



have a higher molecular weight.

Many factors affect carbon adsorption in liquids, such as pH, flow rate, temperature, solubility, concentration of adsorbate, type and number of different adsorbates, viscosity, and the level of adsorbate removal required.

In any stream, there are four steps that occur in order for adsorption to take place. First, the adsorbate molecule must migrate through the bulk of solution toward the carbon particle. This is known as bulk diffusion. Second, the adsorbate penetrates the surface film to reach the exterior surface of the carbon. This is known as film diffusion. Third, the adsorbate diffuses through the transport or large pores. This is known as pore diffusion. Fourth, the adsorbate is adsorbed deep into the micropore structure of the activated carbon. In most water applications, the rate limiting step is the pore diffusion step.

In a typical fixed bed carbon system, the liquid flows down through an adsorber. Initially, the adsorbate is adsorbed onto the top most portion of the carbon. The rate of adsorption will determine the depth of carbon (mass transfer zone) that is utilized to remove the adsorbates. The varying concentration in the mass transfer zone is known as the wavefront.

Eventually, the wavefront moves through the bed and contamination breaks through into the effluent from the bed. This is known as the breakpoint. In a single or parallel adsorber system, the contaminants are usually monitored until the effluent approaches the allowable limit. The adsorber is then taken off-line and the spent carbon is removed. The adsorber is then refilled with fresh carbon and brought back on-line.

In a series mode, the mass transfer zone in the first or lead bed is allowed to pass through the adsorber into the second bed. Usually, when adsorbing multiple components, the first two or three compounds that are being monitored in the effluent from the lead bed are allowed to approach their influent levels, at which point the adsorber is taken off-line.



6.4 FACTORS AFFECTING ADSORPTION

Concentration: With each adsorbate, a high concentration will result in a higher adsorption capacity for that adsorbate on the carbon. For example, if an adsorbate has a one percent loading at 1 mg/l, it might have a three percent loading at 10 mg/l. However, the volume of carbon required to treat a fixed volume of solution will go up if the concentration goes up.

When the concentration of the feedstream changes dramatically, such as when a spill occurs upstream of a potable water plant intake, undesirable effects may occur. Concentrations at the intake of the plant may go up 100 to 1000 times the normal influent concentration. The activated carbon would adsorb the contamination with a higher capacity, if adsorptive capacity was available.

However, upon passage of the spill past the intake, the activated carbon may desorb some of the high level contamination to fresh carbon downstream of the mass transfer zone or into the effluent. When upsets occur, a conservative approximation is to assume that additional carbon is exhausted by the excess contaminant at the original loading rate for the normal influent level.

Another example is when the contaminant concentration in the influent decreases for a period of time. In this instance the adsorbate will start to desorb. The rate of desorption is slower than the rate of adsorption. Therefore, a conservative estimate of the overall effect is that a fixed volume at the reduced influent level will exhaust as much carbon as if the influent concentration was consistently high.

A steady feed concentration will help minimize the amount of carbon that is used in an application. A steady feed would usually be considered to be +/-25% of the average concentration. However, the carbon bed will act to average out upsets and variations, except when the bed is nearly exhausted.

Flow Rate: In many applications, the flow rate to the adsorber is varied because the flow demand changes. As the flow changes, so does the mass transfer zone (MTZ). These changes are approximated by a directly proportional relationship between MTZ length and flow rate. For example, if the MTZ is 1 foot at 250 gpm, it would be 2 feet at 500 gpm. If the flow rate is increased dramatically, the MTZ is further lengthened because some desorption may take place, resulting in less efficient operation. For the optimum carbon usage, the flow rate should be steady (if possible).

In a series configuration, increasing the flow rate usually has a minimal impact. In a parallel mode, this impact is more substantial since the carbon is usually taken off line on the basis of the effluent quality. since the MTZ is lengthened the on-stream time will be shortened.

Viscosity: As viscosity increases in a system, the time to adsorb lengthens, and thus the MTZ lengthens. In a process application the temperature of the feedstream may be raised to offset



increases in viscosity, but if the temperature is raised too high degradation of product may occur or the adsorption capacity of the carbon may be reduced. In water applications, viscosity has minimal impact because it is relatively low.

Temperature: In liquid phase systems, the adsorptive capacity is usually lowered at higher temperatures because the solubility is increased.

Feedstream pH: The pH of the feedstream can impact adsorption efficiency. This impact may be substantial since the pH affects the ionization of the adsorbate. Usually, the more ionic adsorbates have less adsorption capacity. Therefore, organic acids adsorb better at lower pH levels, while organic bases adsorb better at higher pH levels.

Water Characteristics: On each start-up of fresh carbon, the pH of the effluent stream may rise. This occurs because species like sulfates, nitrates and chlorine adsorb and displace alkaline species. The pH will return to normal, depending on water characteristics, after 250 to 350 bed volumes have been treated. If this is a problem, then either acid should be added to the effluent, or the carbon should be allowed to stand in a sodium sulfate solution for 10 to 12 hours.

The carbon has a capacity for sodium sulfate of 1% by weight. Therefore, the water in contact with the carbon should contain a quantity of sodium sulfate at least equal to 2% by weight of the carbon. In a 20,000 pound adsorber this would be 400 pounds of Na_2SO_4 in 5,000 gallons of water.

Solubility: The water solubility of a particular compound is a very good indicator of its adsorptivity. Generally, the more soluble a compound is, the more difficult it is to be adsorbed. Also, a more water soluble compound has a longer MTZ.

Suspended Solids: Suspended solids should usually be taken out of the feedstream before the carbon adsorbers. Suspended solids (>10 microns) will usually be filtered out within the first 6" of carbon and the pressure drop across the carbon will increase. If the pressure drop increases too much, the unit should be backwashed or backflushed. Normally, feed streams containing suspended solids of more than 50 ppm are pre-filtered.

If the suspended solids are finer than 10 microns, the solids will usually not be filtered out by the carbon. The solids would then pass through the carbon into the effluent. This condition is very undesirable because the solids often contain dissolved or attached adsorbate and premature breakthrough can appear to occur. For materials to adsorb they must be in solution, so they can diffuse into the pore structure.

Immiscible Oils and Greases: Immiscible oils and greases have to be separated from the feedstream before the carbon adsorbers. If they are not removed, they may coat the carbon particles with a fine film. The adsorbates will not be able to pass through this film, and the carbon will not be effectively utilized. Oils and grease can also behave as a suspended,



immiscible solid.

Heat of Adsorption: Heat is often given off when molecules are adsorbed. The amount of heat is conservatively estimated at two (2) times the heat of vaporization. In a process stream where the solvent is an organic liquid, a heat-up potential exists if the carbon has not been previously wetted and deaerated properly. Refer to Section 3.3 of this manual for wetting procedures.

Water has too low a heat of adsorption to cause a problem for aqueous solutions.

Competitive Adsorption: In most carbon applications (process, wastewater, groundwater, and potable water), more than one adsorbing compound is in the feedstream. Some of these compounds must be adsorbed while others may be permitted to pass through the carbon bed.

Unfortunately, the activated carbon cannot tell which of the molecules must be adsorbed. All of the components in the feedstream will compete for adsorption space, making the removal of target components less efficient. Therefore, competitive adsorption can cause premature breakthrough of the target component.

6.5 ADDITIONAL ADSORPTION THEORY

Desorption/Displacement: Desorption is the opposite of adsorption and may occur for many reasons. Changes in the feedstream components, temperature, pH, and feedstream concentration may promote desorption. In order to minimize desorption and optimize carbon usage, the feedstream should be stable (if possible). The rate at which desorption takes place is usually much slower than the adsorption rate.

If a more strongly adsorbed organic enters the feed it will desorb the target adsorbate. This forces the target adsorbate to re-adsorb deeper in the carbon bed, and eventually breakthrough will occur.

Roll-over in Competitive Adsorption: When an adsorber system runs beyond breakthrough, the more weakly adsorbed components originally in the feedstream can be desorbed into the effluent. The resulting concentrations may exceed the inlet concentrations. This phenomenon is known as roll-over. In a properly operated column system, roll-over of key components will not be observed in the effluent.

Effect of Bacteria: Higher pressure drops can be a result of bacteria growth in some wastewater applications. This is due to bacteria slime and exhaust gasses from the bacteria. If backwashing does not get rid of the pressure drop problem, then either NaOH washing or higher temperatures will control bacteria growth. Usually, sodium hydroxide washing is used in lined vessels. Do not use biocides, chlorine, or other additives, since they will adsorb and reduce carbon life without affecting the bacteria.

**OPERATING MANUAL - DUAL MODULE
ADSORPTION SYSTEM, CALGON CARBON CORPORATION**



Refer to Section 3.7.2 for sodium hydroxide washing procedures.

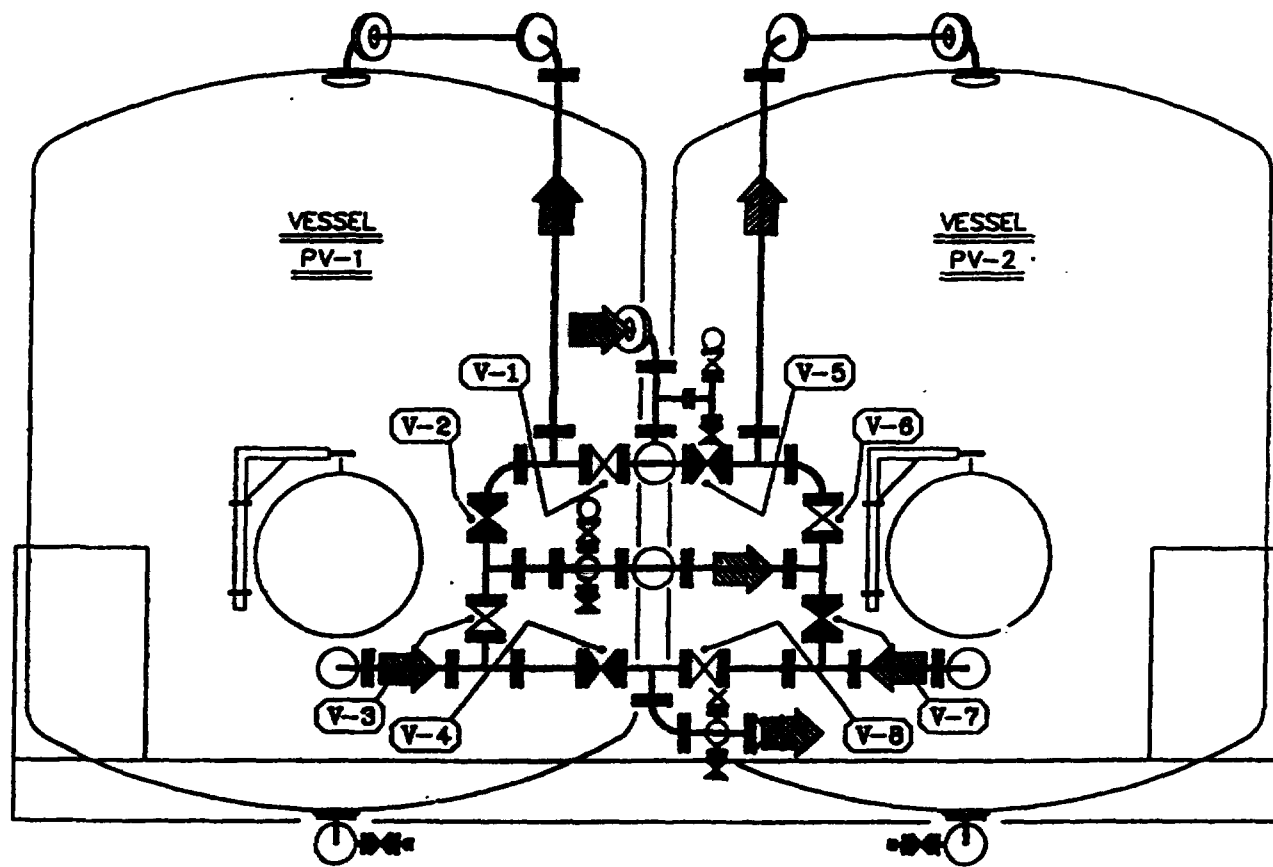


SYSTEM OPERATION VALVE DIAGRAM

SERIES FLOW
VESSEL PV-1 TO PV-2

FIGURE 1

FRONT VIEW



DUAL MODULE SYSTEM
PROCESS PIPING

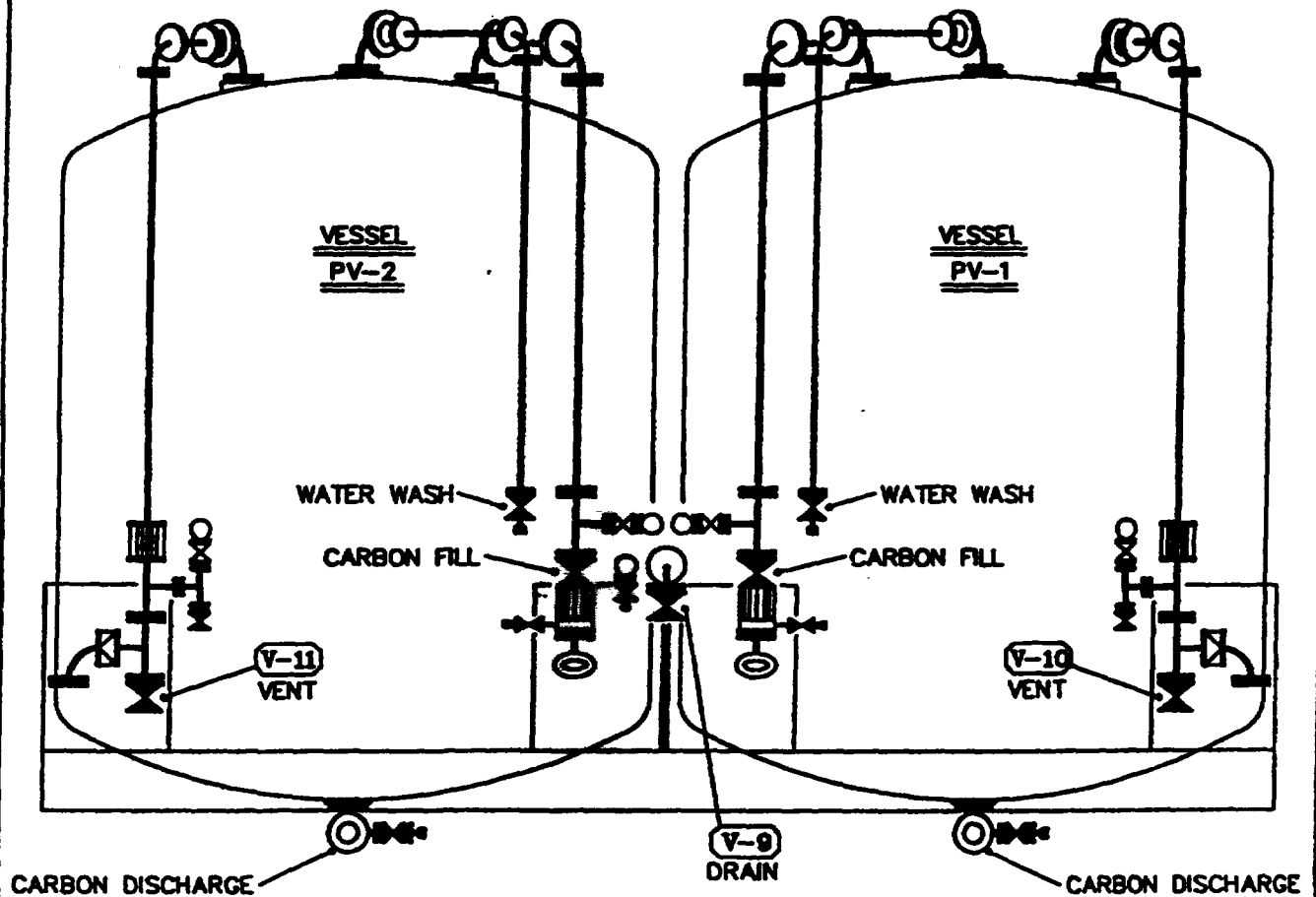
SYSTEM OPERATION VALVE DIAGRAM



SERIES FLOW
VESSEL PV-1 TO PV-2

FIGURE 1

BACK VIEW



DUAL MODULE SYSTEM
UTILITY AND CARBON TRANSFER PIPING

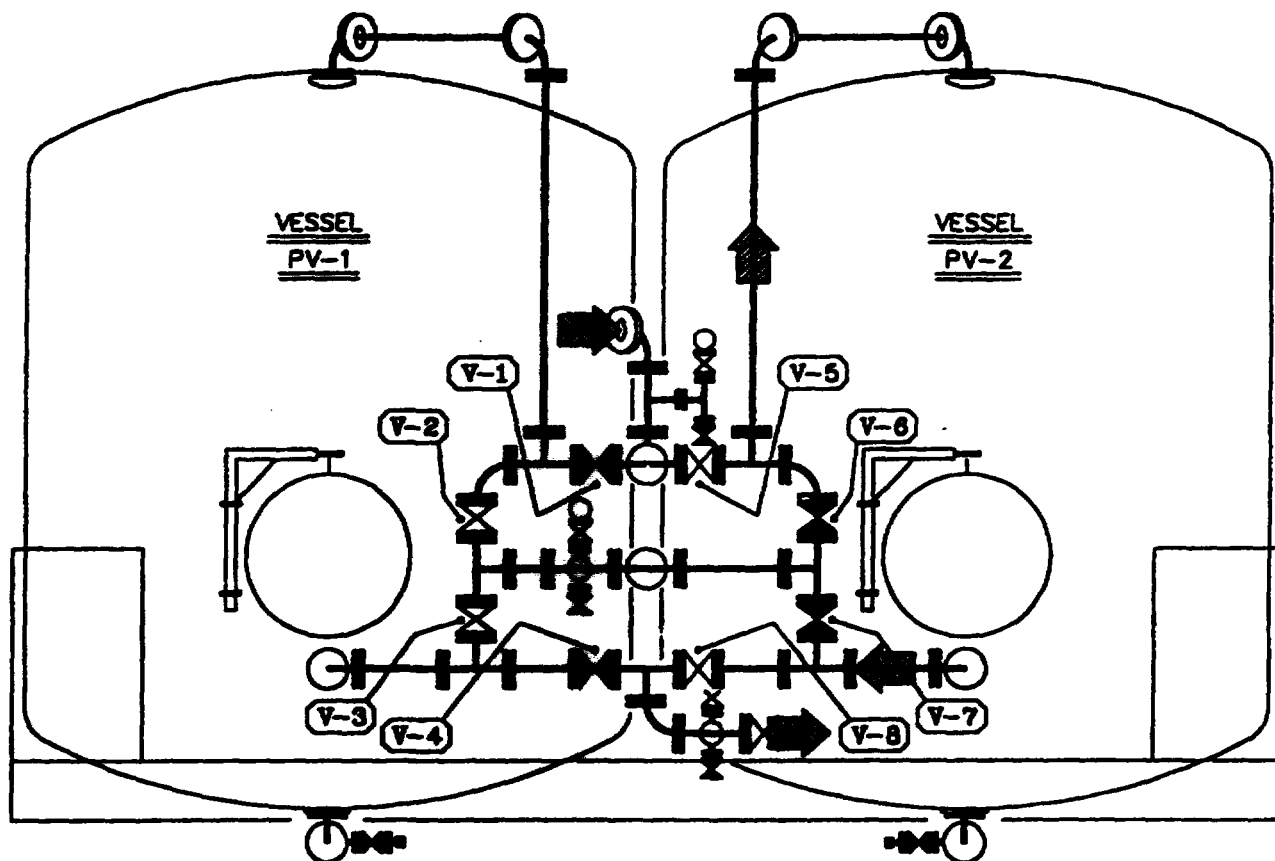


SYSTEM OPERATION VALVE DIAGRAM

FIGURE 2

SINGLE STAGE FLOW
TO VESSEL PV-2

FRONT VIEW



DUAL MODULE SYSTEM
PROCESS PIPING

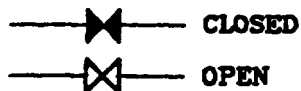
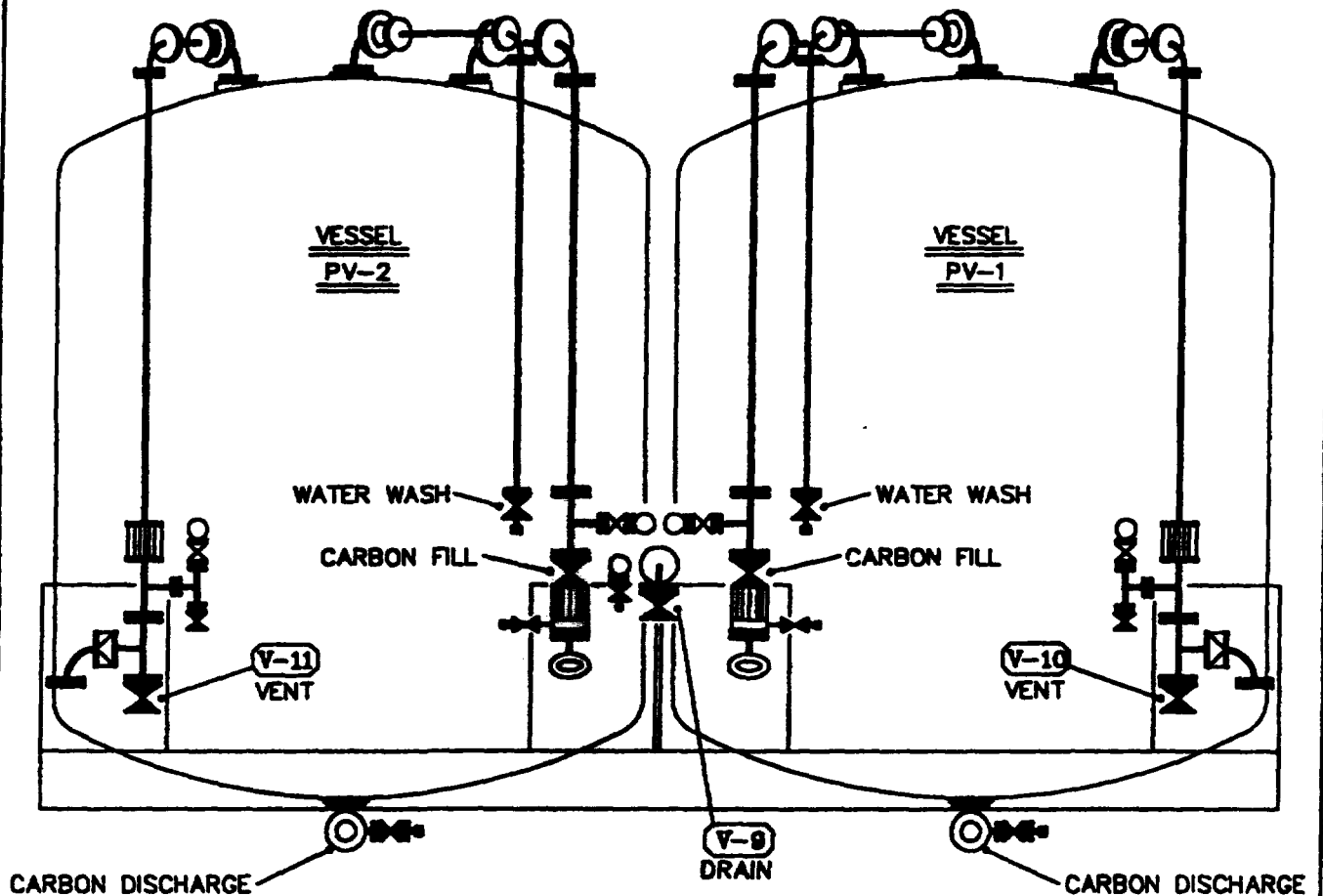
SYSTEM OPERATION VALVE DIAGRAM



SINGLE STAGE FLOW
TO VESSEL PV-2

FIGURE 2

BACK VIEW



DUAL MODULE SYSTEM
UTILITY AND CARBON TRANSFER PIPING

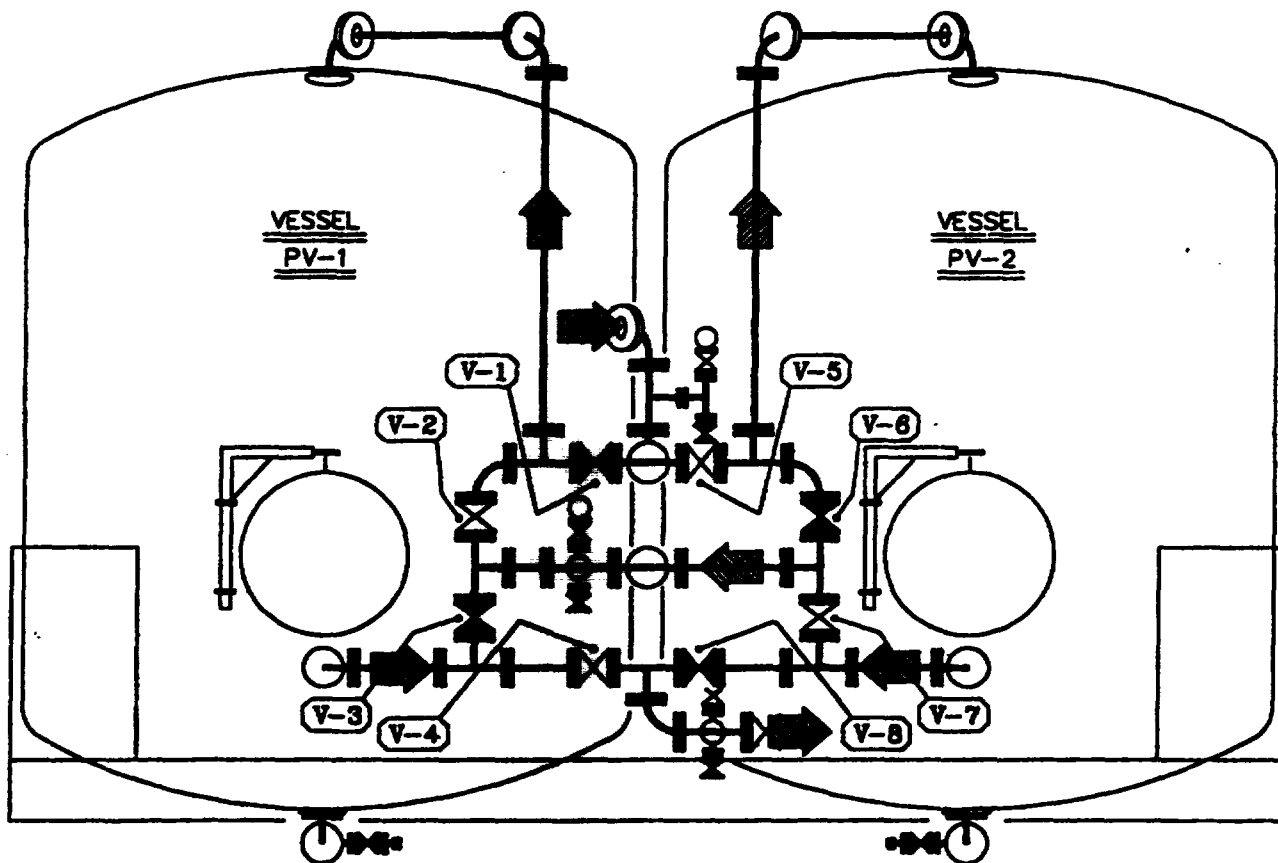


SYSTEM OPERATION VALVE DIAGRAM

FIGURE 3

SERIES FLOW
VESSEL PV-2 TO PV-1

FRONT VIEW



— X — CLOSED
— — — OPEN

DUAL MODULE SYSTEM
PROCESS PIPING

SYSTEM OPERATION

VALVE DIAGRAM

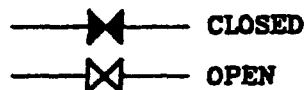
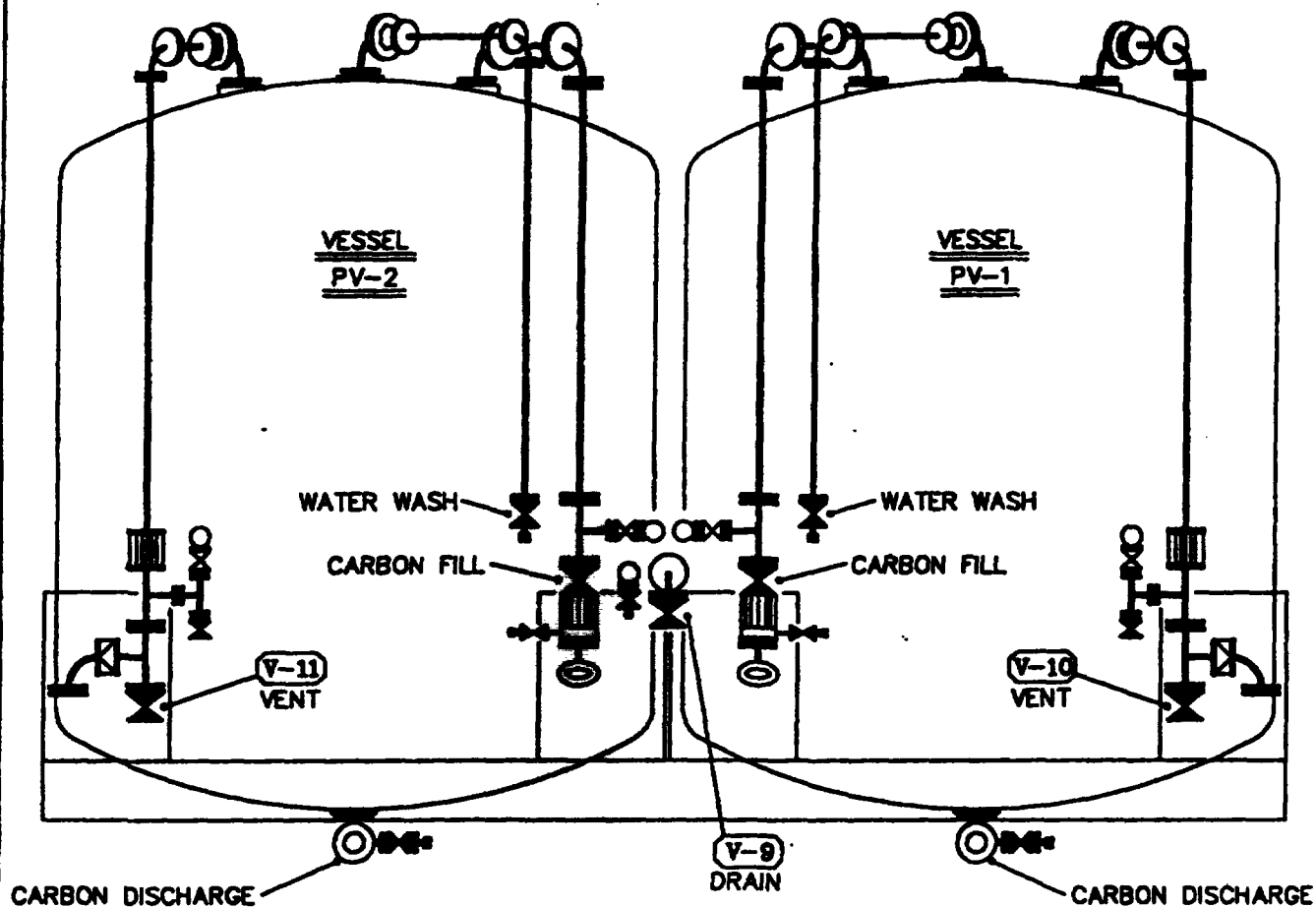
SERIES FLOW
VESSEL PV-2 TO PV-1



CALGON CARBON CORPORATION

FIGURE 3

BACK VIEW



DUAL MODULE SYSTEM
UTILITY AND CARBON TRANSFER PIPING



CALGON CARBON CORPORATION

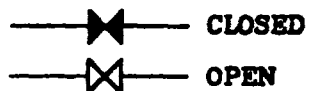
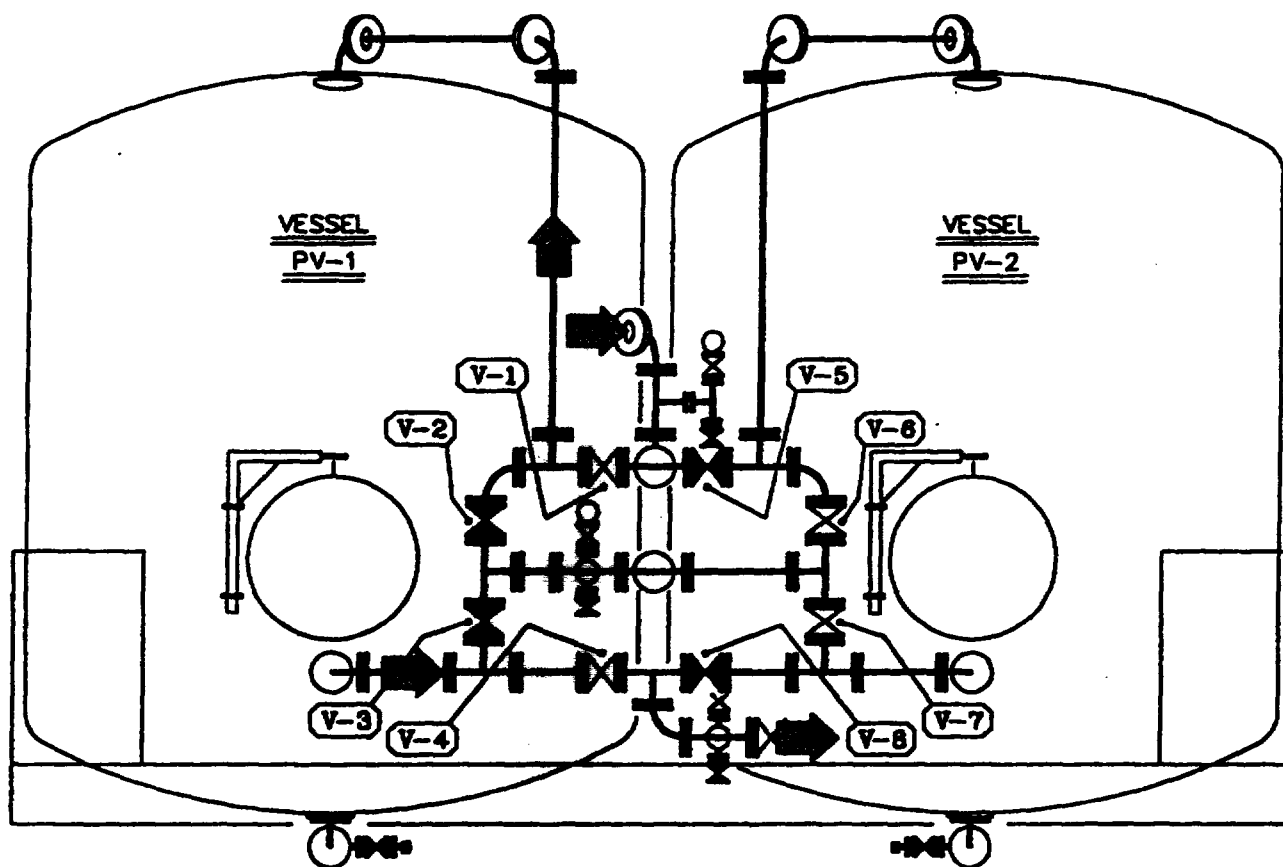
SYSTEM OPERATION

VALVE DIAGRAM

SINGLE STAGE FLOW
TO VESSEL PV-1

FIGURE 4

FRONT VIEW



DUAL MODULE SYSTEM

PROCESS PIPING

SYSTEM OPERATION

VALVE DIAGRAM

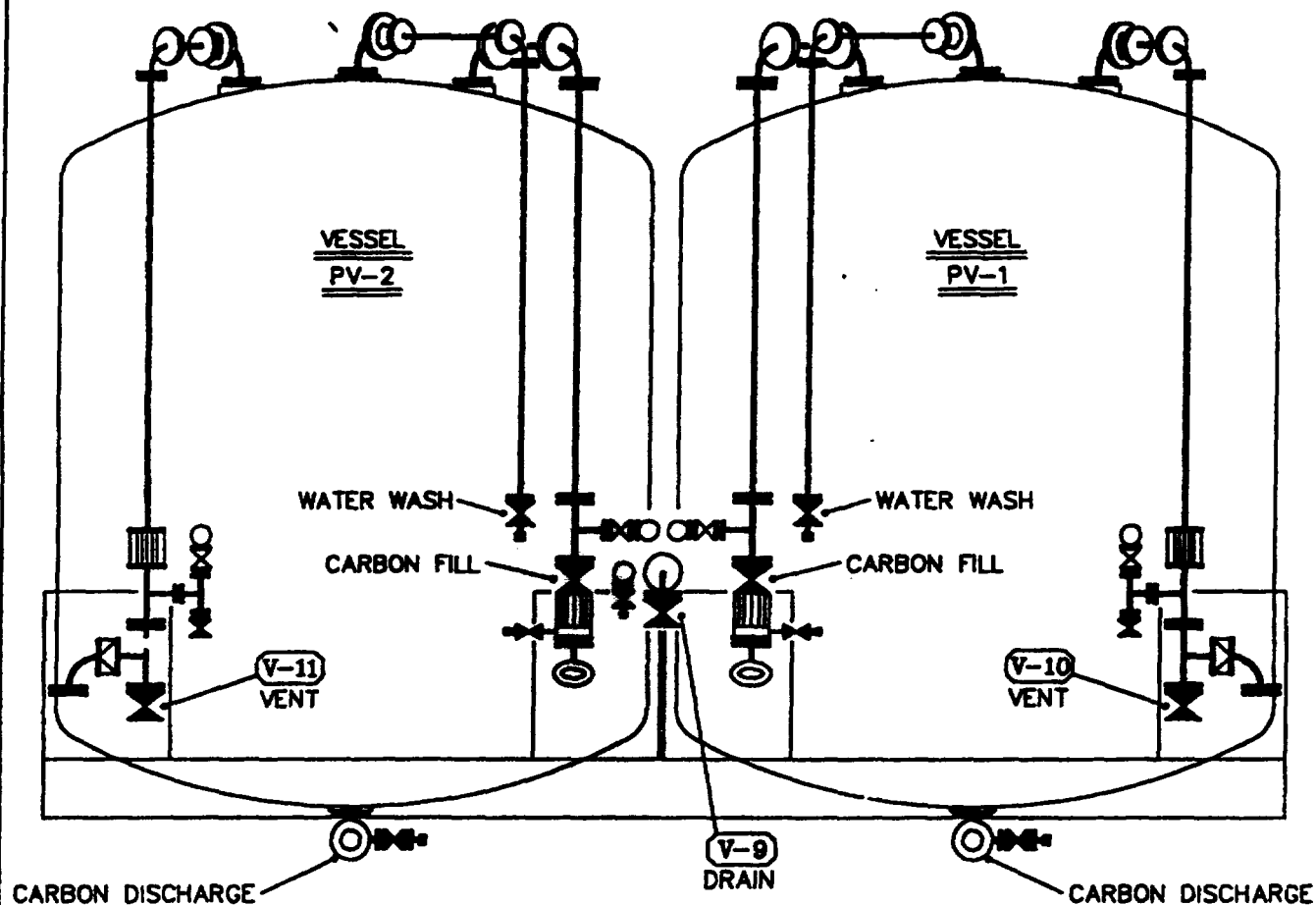
SINGLE STAGE FLOW
TO VESSEL PV-1



CALGON CARBON CORPORATION

FIGURE 4

BACK VIEW



DUAL MODULE SYSTEM
UTILITY AND CARBON TRANSFER PIPING

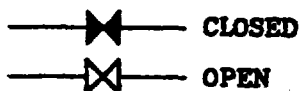
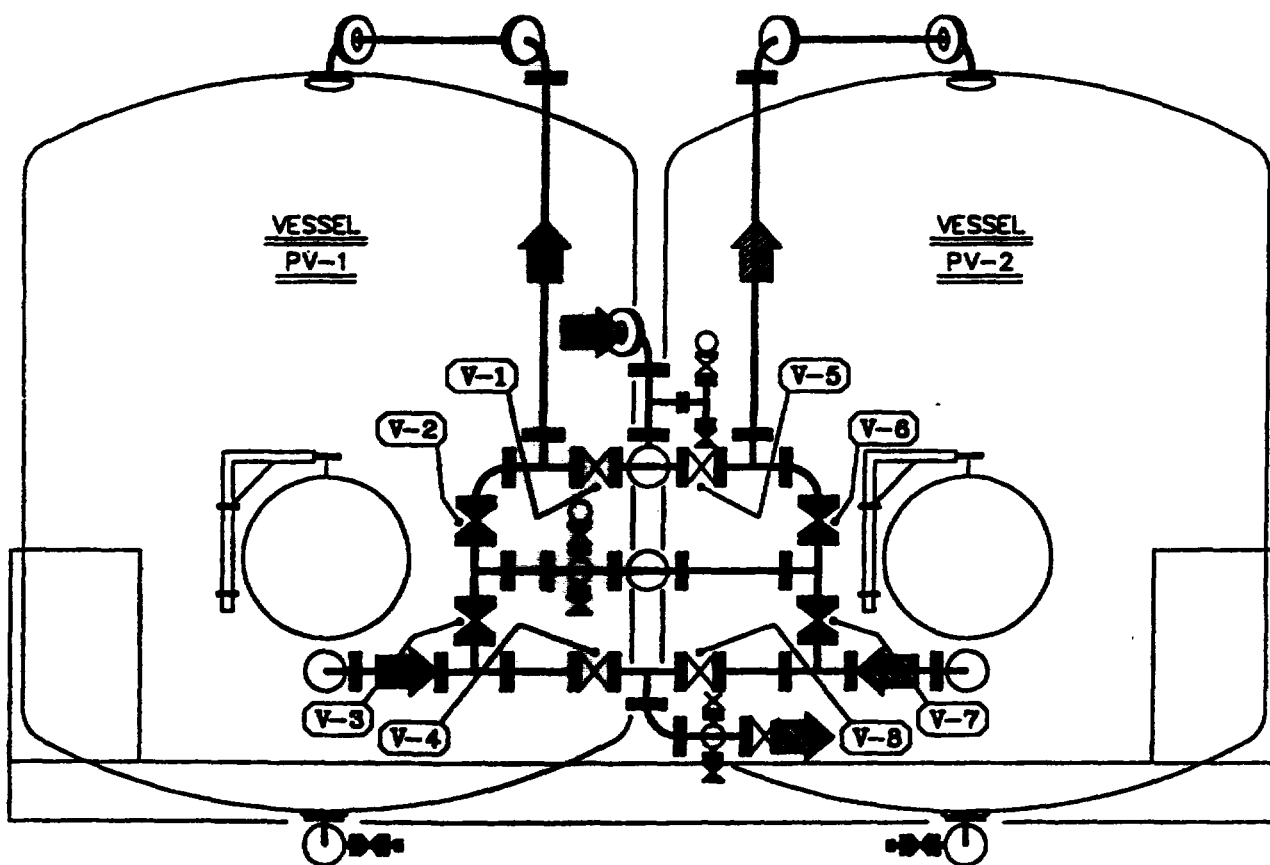


SYSTEM OPERATION VALVE DIAGRAM

PARALLEL FLOW

FIGURE 5

FRONT VIEW



DUAL MODULE SYSTEM
PROCESS PIPING

SYSTEM OPERATION

VALVE DIAGRAM

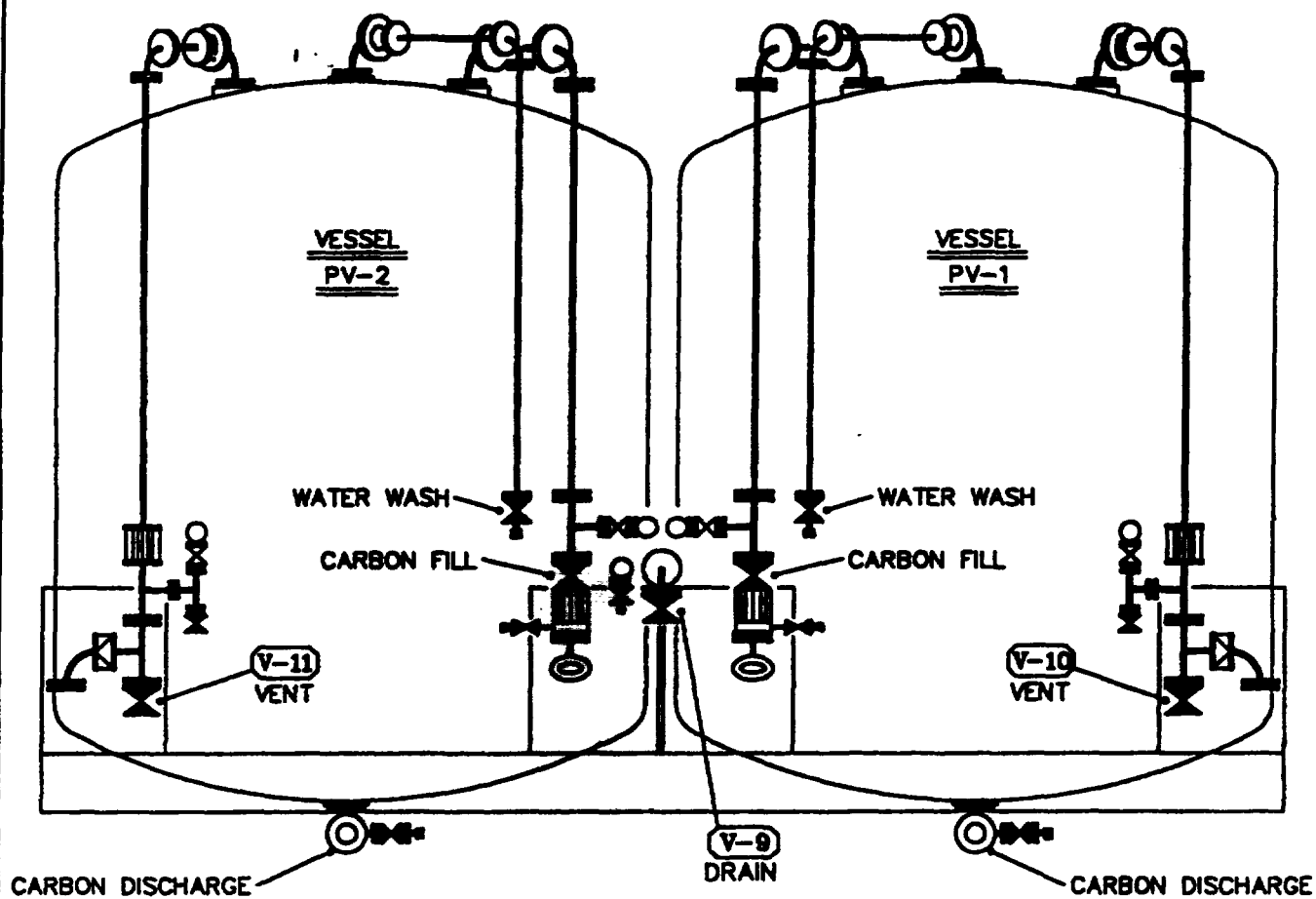
PARALLEL FLOW



CALGON CARBON CORPORATION

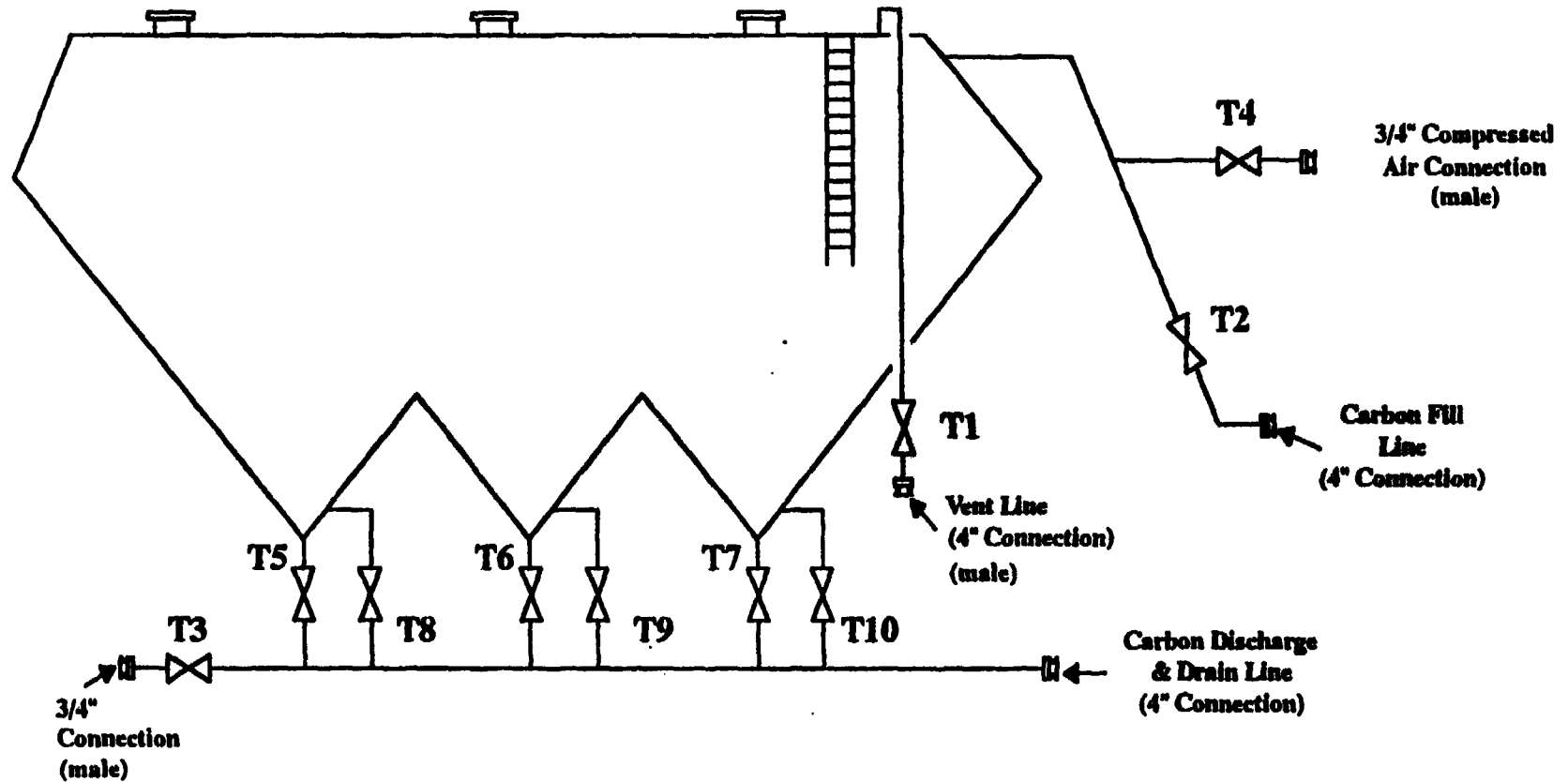
FIGURE 5

BACK VIEW



DUAL MODULE SYSTEM
UTILITY AND CARBON TRANSFER PIPING

Standard Trailer



- Note:**
- 1) For Industrial Trailers, the Carbon Fill & Discharge connections are Kamlock style (male)
 - 2) For Food Grade Trailers, the Carbon Fill & Discharge connections are Kamlock style (female)
 - 3) All other connections are male Kamlock for ALL trailers
 - 4) Maximum Operating Pressure = 15 psig



OPERATING MANUAL - DUAL MODULE
ADSORPTION SYSTEM, CALGON CARBON CORPORATION



WETTED CONTINUOUSLY		
Item	CCC Spec. #	Material of Construction
Process, Utility, Instrument, Carbon Exchange Piping	L1	PPL Lined Steel PPL Lined Cast Iron Fittings
Process, Carbon Exchange Valves	6.08	TFE Lined Ductile Iron
Carbon Exchange Valves	6.08	TFE Lined Ductile Iron
Compressed Air Piping	C13 G2	Sch. 40 Galvanized Carbon Steel Galvanized Iron Fittings Red Rubber Gaskets
Instrument & Utility Valves	5.01	PPL Lined Body TFE Faced Diaphragm
Sample Point Valves	4.03	Bronze/Brass Body, Ball, & Stem TFE Seats, Graphite Seals
Flush Connection Valves (High Pressure Side)	6.12	PPL Lined Cast Iron TFE Bearing Rings Fluorocarbon Packing
Pressure Gauges	PI-444	TFE Diaphragm, Viton Seal
Rupture Disks	PSE-252	Graphite
Sight Glasses (in Vent Lines)	23.29	Pyrex Inner Cylinder Viton "O" Rings PPL End Pieces
Vessel Lining	--	Plasite 4110, vinyl ester
Vessel Manway Gaskets	--	Neoprene
Underdrain Materials	--	PPL Piping PPL Nozzles Tefzel Bolts PPL Supports
WETTED INTERMITTENTLY OR FOR SHORT TIME PERIODS		
Flush Connection Valves (Low Pressure Side)	4.07	316SS Body, Ball, & Stem TFE Seats & Seals
Piping Spacers	36.50	PPL
Quick Connect Couplings	32.32	304SS
Sight Glasses (in Carbon Exchange Lines)	23.29	Pyrex Inner Cylinder Viton "O" Rings PPL End Pieces

Wetted Parts

Rev. 1 5/15/2001

CALGON CARBON CORPORATION

DUAL MODULE CARBON ADSORPTION SYSTEM

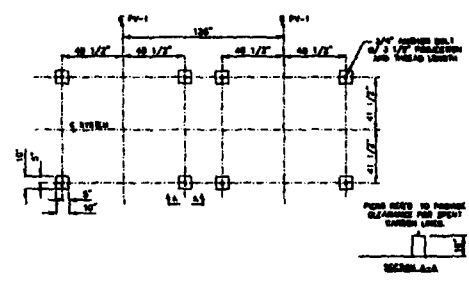
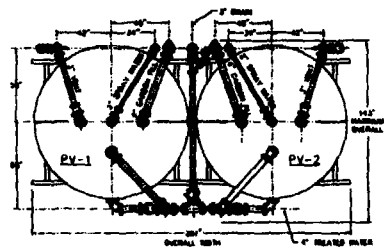
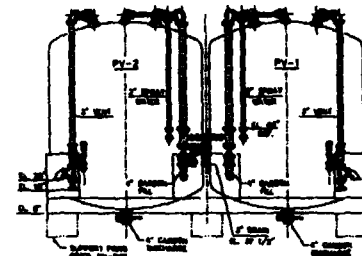
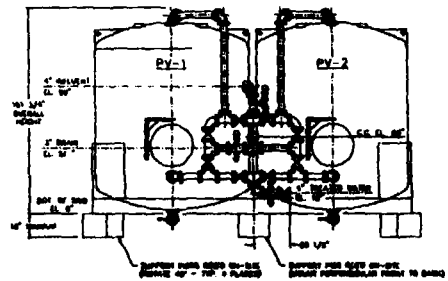
Calgon Carbon Corporation
P.O. Box 717
Pittsburgh, PA 15230

SYSTEM DESCRIPTION

- Vessels**
- Two (2) 10'-0" diameter by 8'-0" straight side height
 - Flanged and dished top and bottom heads
 - Overall height approximately 14'-0"
 - Design pressure 75 psig at 150 degrees F
 - Skid mounted system (Vessels and piping).
 - One (1) 20" diameter flanged round manway on the lower side portion of the vessel.
 - Polypropylene header/lateral underdrain system provided with polypropylene nozzles.
 - Interior of the vessel will be lined with Plasite 4110, vinyl ester lining.
 - Overall installed dimensions 20'-0" long X 14'-0" high (Clear Height) X 11'-2" wide
 - Approximate weight 57,000 pounds empty and 330,000 pounds operating.
- Piping**
- The influent, effluent and backwash piping 3" diameter schedule 40 carbon steel polypropylene lined in accordance with ASTM 53 grade B.
 - The carbon fill and discharge piping 4" diameter schedule 40 carbon steel polypropylene lined in accordance with ASTM 53 grade B.
- Valves**
- The main influent and effluent valves are TFE lined Plug valves, wrench operated, ductile iron body with 150-pound ANSI B16.5 flanged ends. A total of eight (8) plug valves will be provided for the main process operations. Four (4) for backwash control, two (2) for the main influent, two (2) for the effluent and two (2) for the vent valves.
 - The carbon inlet and outlet valves 4 inch TFE lined Plug valves wrench operated, ductile iron body with 150 pound ANSI B16.5 flanged ends. (Total of four (4) valves).
- Instrumentation**
- One (1) 3" rupture disc per vessel (A total of two (2)).
 - Five (5) pressure gauges total.

CALGON CARBON CORPORATION

- Painting** - Exterior surface preparation SSPC-SP2-63, two (2) coats of epoxy mastic paint (Sherwin Williams B58 Series).
- Sight Glasses** - Sight glasses are provided in the carbon exchange and vent piping on each adsorber. (A total of four (4) sight glasses).
- Steel Skid** - The system is provided with a painted carbon steel skid for mounting of the piping and vessels. The vessels will be provided with four (4) structural steel supports legs.



EMPTY WEIGHT: 34000 LBS

PRINTED: 8-22-59

HALLOW

DESIGN ENGINEER

A. A. 88-10

DUAL MODULE

DATE	BY	CHKD	APP'D

REVISIONS

NO.	DESCRIPTION
1	ORIGINAL

